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pt. 2

FLORA MALESIANA

SERIES I - SPERMATOPHYTA
Flowering Plants

Vol. 8, part 2

Revisions

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Monoecious or dioecious (?), evergreen, deciduous or semideciduous shrubs or trees, (in Mal.) unarmed and often buttressed. Growth habit (in Mal.) flush-wise, except for *Trema* and *Parasponia*. Indumentum of simple, bulbous-based unicellular hairs and/or multicellular glandular hairs. Stipules caducous or rarely rather long persistent and completely enclosing the bud, extrapetiolar or intrapetiolar, basally attached or rarely peltately attached to the nodes, free or connate. *Leaves* simple, (in Mal.) alternately arranged, petioled, pinnately nerved or triplinerved at base, often asymmetrical at base, entire or variously serrate. *Inflorescences* 1-many-flowered, ♂, ♀, ♂♀, or ♂♂, axillary, subterminal, or borne on leafless, older branchlets or on short, lateral, leafless new shoots, paniculate, racemose, thyrsoid, cymoid, or rarely capitate, bracteate; bracts minute, caducous. Flowers functionally ♂, ♀, or ♀. — ♂ *Flowers* solitary or in condensed cymoid clusters along the rachis, sessile or short-pedicelled; perianth (4–)5(–7)-lobed, lobes free or variously connate, imbricate or induplicate-valvate in bud; stamens as many as tepals, attached to the base of and opposite the perianth lobes, straight or incurved in bud; anthers ovoid, ellipsoid or subreniform, apiculate or non-apiculate, initially tetrasporangiate, later becoming 2-celled, dehiscing lengthwise, introrse or extrorse; pistillode present or absent, if present either rather well developed or rudimentary, densely whitish to silvery, soft or hirsute pubescent. — ♀ & ♀ *Flowers* sessile or stalked, solitary in the axils of the upper new leaves or arranged in various types of inflorescences; perianth herbaceous or thin-coriaceous, (4–)5(–7)-lobed, lobes always imbricate in bud and connate at base, (in Mal.) long persistent; staminodes or stamens as many as perianth lobes or absent; ovary superior, 2-carpellate, (in Mal.) 1-celled, sessile or stipitate; style 1, tubular, short or absent, stigmatic arms 2, slender, often bifid to deeply lobed at the tip, adaxially papillose-stigmatic for their entire length; ovule 1, anatropous to hemi-anatropous, subapical, pendulous, bitegmic. *Fruit* a drupe or a samara, faintly angular or flat and winged. *Seed* mostly exalbuminous; embryo large, straight or curved; cotyledons flat-convex, fleshy, straight or variously folded, often foliaceous. Germination mostly epigeal.

Distribution. There are 15 genera, c. 200 spp., widely distributed in the tropics, subtropics, and temperate regions of Europe (as far north as 70°, Scandinavia), Africa (South of Sahara), continental Asia, Malesia, Australia (Queensland and New South Wales), Pacific Islands (as far as Tahiti; incl. also Hawaii and the Galapagos Is.), North, Central, and South America (as far south as 40°, Argentina). Fig. 1.

Fossils. Various macrofossils (woods, drupes, and leaf-impressions) and microfossils (pollen grains) attributed to *Ulmaceae* have been reported by different authors from various localities in Alaska, North America, Europe, continental Asia, and Japan. Amongst the older records are pollen grains of the *Ulmus-Zelkova*-type from Golden Valley Formation in North Dakota and Rocky Mountains, U.S.A. (Paleocene) and wood and leaf-impressions attributed to *Ulmus* from Rocky Mountains and to *Planera* from Alaska (Late Paleocene). By the middle of the Eocene and throughout the Miocene and Pliocene fossils of *Ulmaceae* become more abundant (common) in the northern hemisphere, especially in Europe and North America. However, very little is known about the geological history of the family in Asia.

Of the Malesian genera belonging to the tribe *Celtoideae*, fossil records of *Gironniera* (identification very doubtful) go back to Middle Eocene (Alaska), that of *Celtis* to Miocene (Japan), and *Trema* to Upper Oligocene (Japan). — **Literature:** BERRY, Tree Ancestor (1923) 146; WATARI, Jap. J. Bot. 11 (1941) 385; J. Fac. Sc. Un. Tokyo III, 6 (1952) 97; LA MOTTE, Mem. Geol. Soc. Am. 51 (1952) 112, 260, 346, 360; PRAKASH & BARGHOORN, J. Arn. Arb. 42 (1961) 185, 347; GREGUSS, Tert. Angios. Hung., Ak. Kiado Budapest (1969) 83; FERGUSON, Verh. Kon. Ned.

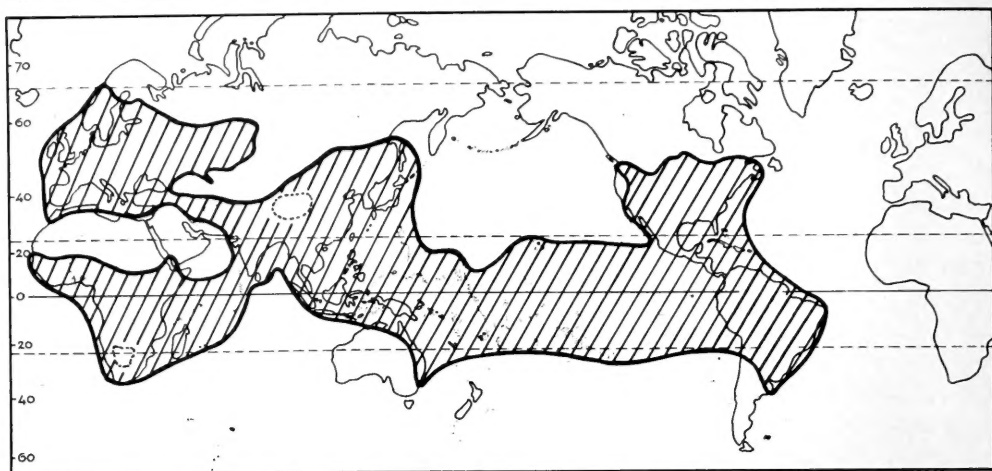


Fig. 1. Approximate range of *Ulmaceae*.

Ak. Wet. sect. II, 60 (1971) 103; LEOPOLD & MacGINITIE in Graham, Flor. & Paleofl. Asia & N.E. America (1972) 147; WOLFE, *l.c.* 200; TANAI, *l.c.* 235; WOLFE, *Brittonia* 25 (1973) 334.

Ecology. In Malesia species of the *Ulmaceae* may be found in both primary and secondary forests, from sea-level up to 2000 m; they are more common in the lowlands and hills.

Apart from *Ulmus lanceaefolia*, *Celtis rigescens*, *Gironniera nervosa* and *G. subaequalis* which may attain up to 45 m in height and 100 cm in diameter, all species are understorey shrubs or trees. Of the 6 genera occurring in Malesia, species of *Aphananthe*, *Celtis*, *Gironniera* and *Ulmus* are basically primary forests inhabitants, though they may survive and thrive in secondary forests as well. Of these, *Celtis* and *Gironniera* species are the most widely spread and may be found growing on various types of soils, including those derived from limestone.

In Malesia *Ulmaceae* are found under both everwet and more seasonal climatic conditions, but some show preference for one or the other. In *Celtis* two groups of species may be distinguished, viz the group of *C. tetrandra*, *timorensis* and *rubrovenia*, and that of *C. philippensis*. The former is either semideciduous or deciduous and found mainly under a drier and more seasonal climate, while the latter is evergreen and grows better in more humid environmental conditions. *Aphananthe* and *Ulmus* species are mainly found in regions subject to a rather distinct seasonal climate, and they are either semideciduous or deciduous. Members of the genera *Parasponia* and *Trema* are pioneer plants preferring and thriving well in newly opened up habitats, e.g. forest clearings, thickets, roadsides, flood-plains, on volcanic ashes, etc. Fig. 10, 11, 17. They are usually short-lived (at least in Malaya, 5–7 years) and soon will die out, particularly when over-grown by the other more aggressive and long-lived pioneer plants, e.g. species of *Macaranga*, *Mallotus*, and *Grewia*, etc. For this reason species of *Trema* and perhaps also those of *Parasponia* are usually not or rarely found in old secondary forest. It also may be noted here that most *Trema* species grow, thrive, and are more widely spread in the western parts of Malesia, while *Parasponias* are more common in the eastern parts, especially in New Guinea.

The structure and position of the inflorescence and flowers, particularly the amount of pollen grains produced and the structure of the stigmas, and also the absence of nectary, seem to suggest that pollination is most likely affected by wind, though insects may not be ruled out altogether as possible agents for pollination.

Except for *Ulmus*, which produces a dry, flat, winged fruit, the other Malesian genera have various types of fleshy drupes which turn to bright yellow, orange, or deep-red in colour when ripe. These drupes are most probably dispersed by various species of frugivorous birds or arboreal mammals. Alternatively, at least in some species, e.g. *Celtis philippensis* var. *wightii* which is very common in coastal vegetation, fruit dispersal may be carried out by water currents. In *Ulmus* the winged fruits are easily dispersed by wind.

It should be noted here that there is a very high percentage of seed abortion in Malesian genera for reasons unknown. This is made good by the production of a great number of flowers and fruits, produced regularly throughout the year or at least twice a year. Except for *Ulmus*, the embryo is protected by a strong, hard and durable endocarp. In all genera endosperm is usually scanty or absent.

Anatomy. For general surveys also covering the older literature see SOLEREDER, Syst. Anat. Dicot. Stuttgart (1899) 860–865 and *ibid.* (1908) 295; METCALFE & CHALK, Anat. Dicot. Oxford (1950) 1271–1278; SWEITZER, J. Arn. Arb. 52 (1971) 523–585. Additional selected references: DEHAY, l'Appareil conducteur foliaire des Urticacées, des Moracées et des Ulmacées (Ordre des Urticales), Arras (1934); JANSSONIUS, Mikr. 6, Leiden (1934) 1–308 (wood anatomy, under *Urticaceae*); LEROY, Bull. Mus. Nat. Hist. Nat. Paris sér. 2, 18 (1946) 118–123 & 180–184 (taxonomy, and anatomy of *Aphananthe*); DEN BERGER, Determinatietabel Malesië, Veenman, Wageningen (1949) (wood identification); RAO, GOVINDU & THIRUMALACHAR, J. Indian Bot. Soc. 29 (1950) 224–226 (aerial roots, *Trema*); JANSSONIUS, Blumea 6 (1950) 407–464 (wood anatomical affinities); DESCH, Mal. For. Rec. 15 (1954) 618–620 (wood); JUTTE, Nova Guinea n.s. 10 (1959) 241–278 (wood); MOSELEY, Brittonia 25 (1973) 356–379 (anatomy and relationships).

SWEITZER's study (*l.c.*) is the most up-to-date survey of leaf and wood anatomy of the *Ulmaceae*. Although his extensive research materials included very few Malesian species his general conclusions are probably largely applicable to the Malesian species as well.

The wood anatomy is indicative of the mutual affinities of all Ulmaceous genera. Shared characters are: predominantly simple vessel perforations, short vessel members, alternate intervessel pits. Fibres with simple to slightly bordered slit-like pits. Parenchyma at least partly vasicentric. Genera of the tribe *Ulmeeae* (in Malesia only represented by *Ulmus lanceaefolia*) have exclusively homocellular rays. In *Celteae* (in Malesia all other genera) at least part of the ray tissue is heterocellular.

The wood of *Ulmus lanceaefolia* differs from all species described in literature in lacking the ring porosity and the typical ulmiform arrangement of vessel clusters (original observation). Instead, its vessel distribution resembles the diffuse porous group of tropical *Celtis* species. In *Celtis* the very striking differences in vessel distribution between tropical and extratropical species are well documented (*cf.* SWEITZER, *l.c.*). Although from SWEITZER's and other publications some quantitative and qualitative differences between Malesian genera of *Celteae* can be deduced, our knowledge is still based on too limited materials to allow conclusions on diagnostic and systematic implications.

The leaf anatomy of *Ulmaceae* at the same time supports its coherence as a family and provides an interesting diversity, of great potential diagnostic and systematic value. All *Ulmaceae* share the dorsiventral leaf architecture. The stomata are confined to the abaxial epidermis and are of the anomocytic type. The indumentum includes bulbous-based unicellular trichomes the walls of which are usually silicified. Mineral inclusions of calcium carbonate or silica in cystoliths (with or without pegs) are of common occurrence. The trichome-complement, presence or absence of mucilage cells, crystal complement, loose or compact structure of the spongy tissue, petiole and midrib vasculature show a considerable diversity. SWEITZER's data and other reports from the literature do not yet allow a leaf anatomical characterization of the individual Malesian taxa, but preliminary studies are indicative that this will be possible if more material is studied.

The entire evidence from vegetative anatomy supports the traditional placement of *Ulmaceae* in *Urticales*. — P. BAAS.

Palynology. Based on size, sculpturing of exine and number of pores, pollen grains of *Ulmaceae* may be divided into two major morphological types, namely the *Ulmus*-type and the *Celtis*-type. In the *Ulmus*-type the pollen are oblate to subspherical, amb convex or straight; (4–)5(–7)-porate, 20–30 by (26–)28–38(–51) μm , pore circular to elliptic, c. 2–3 by 3–4 μm , slightly thickened around its margin; exine rugulate-reticulate. Genera with this type of pollen grains are: *Ampelocera*, *Hemiptelea*, *Holoptelea*, *Phyllostylon*, *Planera*, *Ulmus*, and *Zelkova*. In the *Celtis*-type the pollen is suboblate to spherical, amb convex; (2–)3–4(–5)-porate, pores circular or elliptic (elongated towards the poles), often annular and protruding, c. 2–3 by 3–4 μm ; 17–25 by 19–30 μm ; exine more or less smooth but for very fine (1–1.5 μm) scabrae. This type is found in *Aphananthe*, *Celtis*, *Chaetacme*, *Gironniera*, *Lozanella*, *Parasponia*, *Ptero-*

celtis and *Trema*. It may be noted here that pollen grains of *Gironniera*, *Parasponia* and *Trema* are usually slightly smaller and have finer exine sculpturing than those of other genera with *Celtis*-type of pollen, while the pollen grains of the Malesian species of *Trema* and those of *Parasponia parviflora* MIQ. are predominantly diporate. As for pollen grains, *Ulmaceae* are very closely allied to *Moraceae* and *Urticaceae*, particularly to the former. According to NAIR (1967) the pollen type found in *Ulmaceae*, *Moraceae* and *Urticaceae* is derived from a tricolpate type of Ranalean stock. — *Literature*: ERDTMAN, Pollen Morph. & Taxon. 1 (1956) 442; IKUSE, Pollen Grains of Japan (1956) 62; PRAGLOWSKI, Grana Palyn. 3 (1962) 45–65; KUPRIANOVA, Kom. Bot. Inst. Ac. Sc. USSR 1 (1965) 54–58; NAIR & SHARMA, Bot. Notis. 118 (1965) 177–186; STRAKA, Pollen et Spores 8 (1966) 241–264; NAIR, Rev. Palaeobot. & Palyn. 3 (1967) 81–91; MALLIK & CHAUDHURI, Bull. Bot. Soc. Beng. 22 (1968) 105–108; TSUKADA, Bot. Mag. Tokyo 81 (1968) 385–395; RAO & LEE, Pacif. Sc. 24 (1970) 255–268; HUANG, Pollen Fl. Pl. Taiwan (1972) 235; SOWUNMI, Grana Palyn. 13 (1973) 145–186; ADAMS & MORTON, Atl. Pollen Trees & Shrubs Canad. & U.S. 9 (1974) pl. 17; STOCKMARR, Grana Palyn. 14 (1974) 103–107; KEDVES & PARDUTZ, Acta Biol. Szeged. 20 (1974); HAMILTON, Pollen et Spores 18 (1976) 54–57.

Embryology. Apart from several species of *Ulmus* and *Holoptelea* very little is known about the sporogenesis and embryogenesis of the *Ulmaceae*. From a very limited information so far published it appears that the anthers are initially tetrasporangiate but become bisporangiate just before anthesis through the breakdown of the adjoining wall between the locules. The anther-wall development conforms with the so-called basic-type in which the parietal cells divide both anticlinally and periclinally to form the endothesium layer, two (*Trema* and *Ulmus*) or three to four (*Holoptelea integrifolia*) middle-layers and glandular tapetum. Simultaneous cytokinesis in the microspore mother-cells follows meiosis and as a result the pollen grains are initially arranged in either tetrahedral or decussate tetrads. At anthesis the pollen grains are either 2-celled (*Holoptelea* and *Trema*) or 3-celled (*Ulmus*). In *Celtis*, *Holoptelea* and *Trema* up to 80% of the pollen grains produced are sterile or imperfectly developed. The ovule is anatropous to hemianatropous, bitegmic, crassinucellar or tenuinucellar (in a few species of *Ulmus*) with the micropyle formed by both integuments (*Celtis* and *Trema*) or by the inner integument only (*Holoptelea* and *Ulmus*). In *Holoptelea* and *Trema* the megaspore mother-cell divides into 4 daughter cells arranged in a linear tetrad, and of these only the chalazal megaspore develops into *Polygonum*-type of embryo-sac. In *Ulmus*, however, the embryo-sac is tetrasporic and either belongs to *Adoxa*- or *Drusa*-type or variation of these two types with 4–12 antipodal cells. The pollen tube enters the ovule either through the micropyle, the integuments or the chalaza. Endosperm formation is nuclear and the tissue is either diploid or triploid and later becomes cellular. Embryo development conforms with the Onagrad-type in *Holoptelea* and Solanad-type in *Ulmus*. Polyembryony is a common phenomenon, especially in *Ulmus*. The mature embryo is straight with broad, flat or plano-convex, equal or slightly unequal cotyledons in *Holoptelea*, *Planera*, *Phyllostylon*, *Ulmus*, and *Zelkova*, or curved with ascending hypocotyle and narrow, incurved or induplicate-plicate or variously folded cotyledons which are mostly unequal in length in *Ampelocera*, *Aphananthe*, *Celtis*, *Gironniera*, *Parasponia*, *Pteroceltis* and *Trema*. — *Literature*: SHATTUCK, Bot. Gaz. 40 (1905) 205–223; LELIVELD, Rec. Trav. Bot. Néerl. 32 (1935) 543–573; CAPOOR, Beih. Bot. Centralbl. 57 (1937) 233–249; WALKER, Am. J. Bot. 37 (1950) 47–52; HJELMQVIST & GAZZI, Bot. Notis. 118 (1965) 329–360; DAVIS, Syst. Embryol. Angiosp. (1967) 266–267.

Chromosomes. From various published data it seems that the chromosome number in the *Ulmeeae* (*Holoptelea*, *Ulmus*, and *Zelkova*) is $n = 14$ and $2n = 28, 42$, and 56 , though reports of $n = 15$ and 30 have been made on *Ulmus americana*. In the *Celtideae* the number seems to be less constant varying from $n = 10, 2n = 20, 28, 40$ in *Celtis* (9 spp.); $n = 30, 2n = 84$ in *Chaetacme* (2 spp.); to $n = 10, 10 + B, 18, 20$, and 80 in *Trema* (3 spp.). It may be noted here that as for chromosome number, *Ulmaceae* seems to be closely related to *Moraceae* where $n = 12–16$, $2n = 24, 26, 28, 42, 56$, and 84 , and to *Urticaceae* of which $n = 14, 28$ and $2n = 22, 24, 28, 52$, and 84 . — *Literature*: KRAUSE, Ber. Deut. Bot. Ges. 48 (1930) 9–13; Planta 13 (1931) 29–84; WALKER, Science 75 (1932) 107; SAX, J. Arn. Arb. 14 (1933) 82–84; BOWDEN, Am. J. Bot. 32 (1945) 195; DARLINGTON & WYLIE, Chromos. Atlas Fl. Pl. (1955) 182–183; MANGENOT & MANGENOT, Bull. Jard. Bot. Brux. 28 (1958) 315–329; ARORA, Bull. Bot. Surv. India 2 (1960)

305; GAJAPATHY, Bull. Bot. Surv. India 3 (1961) 49–51; GRUDZINSKAJA & ZAKHARYEVA, Bot. Zhurn. 52 (1967) 641–651; HSU, Taiwania 13 (1967) 117–129; MEHRA & GILL, Taxon 17 (1968) 574–576; J. Arn. Arb. 55 (1974) 663–677; FEDOROV (ed.), Chromos. Numb. Fl. Pl. (1969) 710–711; GADELLA c.s. Acta Bot. Neerl. 18 (1969) 74–83; MEHRA & HANS, Taxon 18 (1969) 310–315; TATAYUK & TURCHANINOVA, Tsitologia & Genetika 4 (1970) 397–401; HANS, Cytologia 36 (1971) 341–345; NIEHAUS, Taxon 20 (1971) 355; MEHRA, Nucleus 15 (1972) 64–83; SARKAR, Taxon 22 (1973) 652.

Chemotaxonomy. SOLEREDER mentioned the more or less general occurrence of cystoliths and cystolith-like structures ($\text{SiO}_2 + \text{CaCO}_3$) in *Ulmaceae*. The tendency to accumulate carbonate of lime seems to be very strong in this family; CaCO_3 is deposited in wall structures (e.g. hairs, cystoliths) and in cell lumina (e.g. in heartwood of *Ulmus* and *Celtis*; in seed coat cells of *Celtis*). Often oxalate of lime is also present in large amounts; solitary and clustered crystals occur in the family. Anatomically easily detectable internal excretion comprises also mucilage production. The mucilage is deposited in epidermal cells (many taxa) or in mucilage idioblasts in the mesophyll of some genera and in barks and flowers of most species of *Ulmus*. The bark of *Ulmus rubra* MUHL. ('Slippery Elm') was used formerly as a mucilaginosum in official medicine. In mucilage-rich elm barks large mucilage idioblasts may develop to lysigenous mucilage cavities. Chemically elm bark mucilages are characterized by a high content of galacturonic acid, galactose, 3-O-methylgalactose and rhamnose. *Ulmaceae* are moderately strong accumulators of polyphenolic compounds. Derivatives of caffeic acid, catechins, pro-anthocyanidins (formerly leucoanthocyanidins), flavonols (especially glycosides of kaempferol and quercetin) and condensed (= flavanoid) tannins seem to occur more or less ubiquitously in leaves, fruits, barks and woods. According to LEBRETON flavonoid constituents with a trihydroxylated B-ring (in casu myricetin and prodelfinidin), an assumedly primitive feature, are restricted to *Celtideae*. (+)-Catechin was definitely identified in leaves, twigs and barks of European elms and its 7-xyloside was isolated from the stem-bark of *Ulmus americana* L. C-Glycoflavons (tremasperin) occur in leaves of *Trema aspera* BL., and the wood of *Zelkova serrata* (THUNB.) MAKINO contains large amounts of the fungistatic 6-C-glucoflavonoids keyakinin and keyakinol. Tannin contents of woods, barks, leaves and fruits are moderate (mostly less than 10%). There is only one report in literature indicating a possible co-occurrence of galli- and ellagitannins with condensed tannins in *Ulmaceae*; bark and wood of *Celtis australis* L. contain gallic acid and derivatives of ellagic acid according to CHARI c.s. (1968).

Much chemical work was performed with elm barks and especially elm woods in connection with 'Dutch Elm Disease'. Cadinane-type oxygenated sesquiterpenes seem to be present in the young wood of every species. On aging (heartwood formation) or after fungal infection, synthesis and accumulation of fully aromatic (cadalenal, hydroxycadalenal) and (or) o-quinonoid (the mansonones) cadinane derivatives take place in American elm species belonging to the sections *Trichoptelea*, *Microptelea* and *Chaetoptelea*; they seem to be absent from the sections *Blepharocarpus* and *Madocarpus* in which all European elms are included. It deserves mentioning that the antifungal cadalenals and mansonones represent phytoalexin-like stress compounds in *Ulmus*, and occur at the same time as normal heartwood constituents in *Ulmus* and *Zelkova* (but not in *Celtis*); they are chemically identical with, or biochemically closely related to the gossypol-mansonone-group of constituents of many *Malvaceae*, *Bombacaceae* and *Sterculiaceae* (mansonones were first detected in the wood of *Mansonia altissima* A. CHEV.). It was recently shown that hemigossypol, the precursor of the long-known gossypol, is a phytoalexin in many malvaceous plants and that p-quinonoid derivatives of hemigossypol are engaged in the plants resistance against attack by several phytophagous insects (J. R. GRAY c.s. J. C. S. Chem. Commun. 1976, 109; J. A. VEECH c.s. l.c. 144). As far as ecological chemistry (defensive substances) is concerned, *Ulmaceae* much resemble members of the order *Malvales*. Leaf, bark and wood waxes were investigated by several authors in recent time. They seem to consist mainly of alkanes, long-chain fatty acids, wax alcohols and phytosterins. Additionally pentacyclic triterpenes are often present; β -amyryn (i), lupeol (ii), betulin (iii), friedelin (iv), friedelanol (v), moretenol (vi), simiarenol (vii) and simiarenon (viii) were reported from leaves and (or) barks of *Celtis australis* L. (iii), *C. laevigata* WILLD. (vi), *Holoptelea integrifolia* PLANCH. (iv, v), *Trema guineensis* FICALHO (reported as *T. orientalis* BL.; vii, viii), *Ulmus americana* L. (ii, esterified with cerotinic acid) and *Zelkova*

serrata MAKINO (iv). The heartwood of *Holoptelea integrifolia* PLANCH. yielded 2 α -hydroxy-3-epioleanolic acid (G. MISRA c.s. *Planta Medica* 27, 1975, 290); this is the only triterpenic acid isolated hitherto from *Ulmaceae*. Seeds of *Ulmaceae* seem to store predominantly proteins and fatty oils. The oils have linolic (*Celtis*, *Chaetacme*, *Trema*), oleic (*Holoptelea*) or capric (*Ulmus*, *Zelkova*) acids as main fatty acid. Species of *Celtis* and *Pteroceltis* accumulate small amounts of quebrachitol in leaves; this cyclitol could not be detected in leaves of species of *Ulmus* and *Zelkova* (*Hemiptelea* included). Alkaloid-like compounds are recorded in literature from members of *Ampelocera*, *Aphananthe*, *Celtis*, *Gironniera*, *Trema* and *Ulmus*, but only in the case of *Ampelocera ruizii* KLOTZSCH an alkaloid-like compound isolated from leaves was chemically identified; it proved to be an α -pyridone derivative related to trigonelline (R. H. BURNELL c.s. *Lloydia* 38, 1975, 444). The foetid smell of some *Celtis* woods of India, Indonesia ('*kaju tai*') and Africa is caused by skatol. Several species of *Ulmaceae* are reported to be toxic in literature. GRESHOFF isolated a toxic bitter principle from the leaves of *Aphananthe aspera* (THUNB.) PLANCH. (= *Homoioceltis aspera* BL.) which he compared with his streblide (from *Streblus asper* LOUR.; streblside is now known to be a cardenolide). Leaves of *Trema cannabina* LOUR. (= *Sponia virgata* PLANCH.) and of *T. aspera* BL. (= *T. cannabina*) were reported to be cyanophoric; both species, however, are polymorphic with regard to cyanogenesis if the botanical identification of all plant samples investigated hitherto was correct. Leaves of *T. aspera* (= *T. cannabina*) contain another toxic principle called trematoxin; its chemical structure is not yet known.

From the taxonomic point of view three facts deserve special mentioning: (1) *Ulmaceae* are generally included in *Urticales*; their chemistry agrees rather well with such a classification as is indicated by patterns of mineralisation and phenolic compounds. (2) The chemistry of *Ulmaceae* resembles members of *Malvales* in several respects: chemistry of stress compounds; mucilages with high contents of galactose, rhamnose and galacturonic acid; some features of the polyphenolic and triterpenic patterns. (3) The classification of *Ulmaceae* in *Ulmoidae* and *Celtidoideae* (ENGLER's Syllabus 2, 1964) or *Ulmeae* and *Celtideae* (HUTCHINSON, General of Flowering Plants 2, 1967) is not very satisfactory from the chemical point of view (see cadinane-type sesquiterpenes including mansonones and capric acid as main fatty acid in seed oils in *Ulmus* and *Zelkova*, but not in *Celtis*).

For more phytochemical details and references see my 'Chemotaxonomie der Pflanzen' 6 (1973) 545-554, 762-763, 791, 796. — R. HEGNAUER.

Taxonomy. The family name *Ulmaceae* was first introduced and defined by MIRBEL in 1815, at which time it included only *Celtis* and *Ulmus*. LINK (1831) proposed splitting *Ulmaceae* into two separate families, i.e. *Ulmaceae* to include *Ulmus* and related genera, and *Celtidaceae* comprising *Celtis* and its allies, an opinion which was supported by GRUDZINSKAYA (1967). However, all contemporary taxonomists generally agree to regard *Ulmaceae* as a natural taxon closely related to *Moraceae* and *Urticaceae* and to include these families in the order *Urticales*. Any difference of opinion is usually restricted to the inclusion or exclusion of a few genera in the family. In the most recent treatise, HUTCHINSON (1967) divided the family into two tribes, namely the *Ulmeae* (flowers bisexual, fruit not drupaceous, embryo straight, cotyledons flat or longitudinally folded) to include: *Holoptelea*, *Planera*, *Phyllostylon*, and *Ulmus*, and the *Celtideae* (flowers unisexual or sometimes bisexual, fruit drupaceous, embryo curved, cotyledons mostly variously folded) comprising *Ampelocera*, *Aphananthe*, *Celtis*, *Chaetacme*, *Gironniera*, *Hemiptelea*, *Lozanella*, *Mirandaceltis*, *Parasponia*, *Pteroceltis*, *Trema* and *Zelkova*. This subdivision was supported by SWEITZER (1971) who studied the anatomy of leaf and wood. However, as has been mentioned under Embryology and Palynology, the embryo of *Zelkova* is straight, and the pollen (also of *Ampelocera* and *Hemiptelea*) belongs to the *Ulmus*-type (see also ERDTMAN, 1956). Furthermore in many species of *Celtis* the flowers are bisexual, and in *Ulmus lanceaefolia* and *U. parvifolia* the flowers are either functionally male or female. This seems to indicate that the tribal subdivision as proposed by HUTCHINSON is not a clear cut case, but that *Ulmaceae* is a natural taxon. It should be noted further that the Mexican genus *Mirandaceltis* is in the present study regarded as congeneric with *Aphananthe*.

As for phylogenetic relationship, there seems to be two different opinions. BESSEY (1915) and THORNE (1968, 1973) placed *Ulmaceae* along with *Moraceae* and *Urticaceae* in the superorder

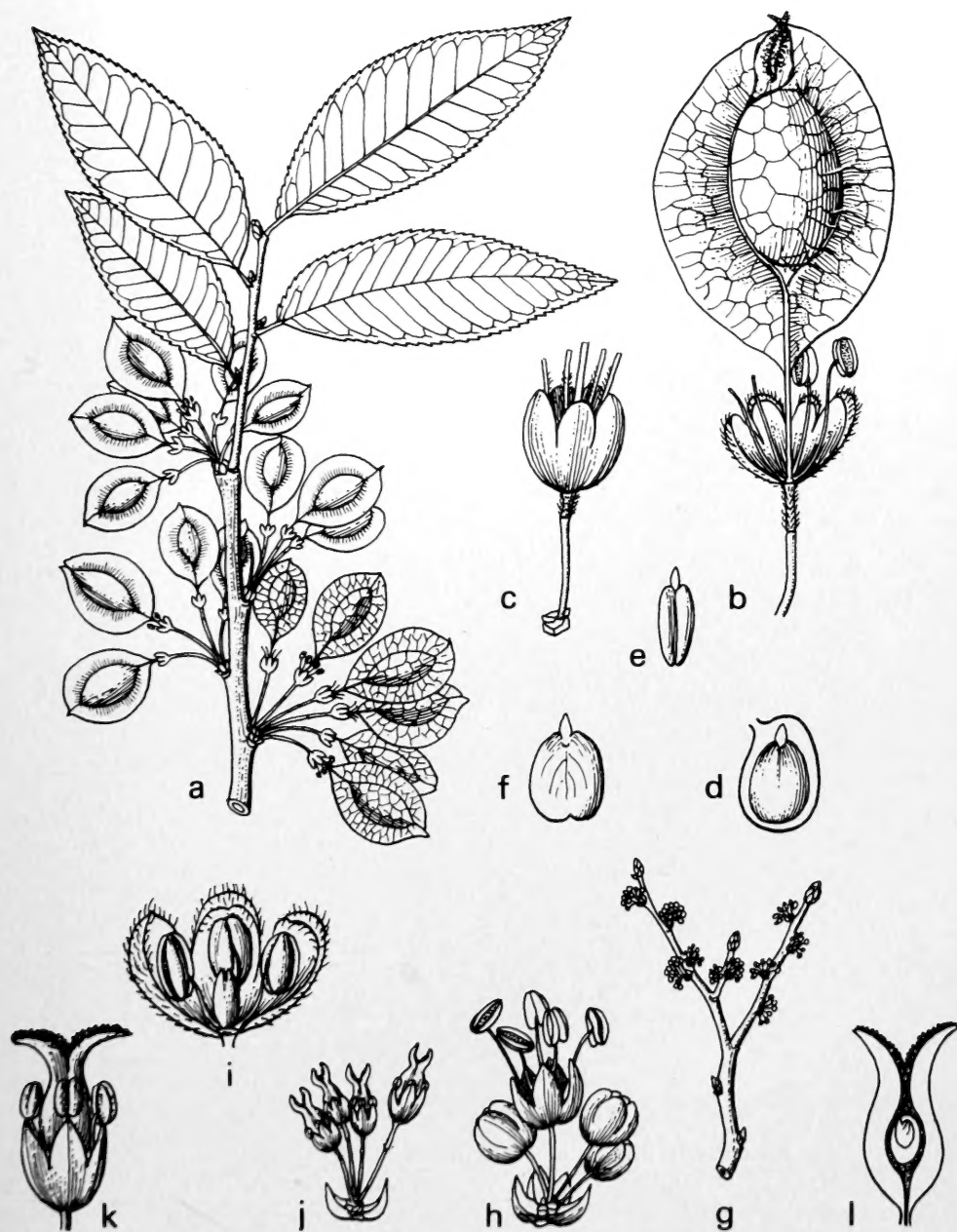


Fig. 2. *Ulmus lanceaefolia* ROXB. ex WALL. a. Habit, nat. size, b. fruit, $\times 2$, c. persistent cup-shaped perianth, $\times 2$, d-e. embryo, nat. size, g. flowering twig, $\times \frac{2}{3}$, h. cluster of δ flowers, $\times 8$, i. δ flower, $\times 14$, j. cluster of γ flowers, $\times 2$, k-l. γ flower, $\times 6$ (a-f HANSEN c.s. 11265, g-i SCHMUTZ 3024, j-l LISTER 31).

Malviflorae, and considered them as families having a very close affinity to or derived from the *Malvales*. On the other hand, authors such as HUTCHINSON (1967), CRONQUIST (1968), TAKHTAJAN (1969), SWEITZER (1971), etc., are of the opinion that *Ulmaceae*, *Moraceae*, and *Urticaceae* are closely allied to or have been derived from the *Hamamelidales*. — *Literature*: MIRBEL, *Elém. Phys. Veg. Bot.* (1815) 905; LINK, *Handb.* 2 (1831) 445; BESSEY, *Ann. Mo. Bot. Gard.* 2 (1915) 109–164; ERDTMAN, *Pollen Morph. & Pl. Tax.* (1956) 442–443; GRUDZINSKAYA, *Bot. Zhurn.* 52 (1967) 144–150; HUTCHINSON, *Genera of Flowering Plants* 2 (1967); CRONQUIST, *Evol. & Class. Fl. Pl.* (1968) 166–167; THORNE, *Aliso* 6 (1968) 57–66; Brittonia 25 (1973) 395–405; TAKHTAJAN, *Fl. Pl. Orig. & Disp.* (1969) 210–212; SWEITZER, *J. Arn. Arb.* 52 (1971).

Uses. 1. Timber. Throughout the north temperate regions the tough, strong and durable wood with attractive appearance and excellent bending quality of many species of *Celtis* and *Ulmus* is extensively used for various purposes including shipbuilding, panelling, furniture, boxes, crates, veneers, etc. and that of *Zelkova* and *Phyllostylon* for making weaver's shuttles, scales, piano-keys, etc. In Central America timber of *Chaetoptelea* (= ?*Ulmus*) is used for railway sleepers, frames and wheels of vehicles. In Africa and India wood of *Holoptelea* is utilized for various building purposes. In Malesia and neighbouring countries except *Aphananthe cuspidata*, *Celtis rigescens*, *C. hildebrandii*, *C. tetrandra*, *Gironniera nervosa*, *Ulmus lanceaefolia* and a few others, the trees seldom reach timber size, and as a consequence very little is known about their usage. Of these species the timber is locally used for making planks in house-building and other light constructions. The soft wood of *Trema* and other species of *Gironniera* is used locally for making tea-chests and match-sticks, for firewood and charcoal.

2. Bark. Due to the high content of mucilagenous substances, decoction of barks of *Holoptelea*, *Parasponia*, *Trema* and *Ulmus* mixed with some other ingredients is used in local folk medicines to cure ailments such as inflammation of mucous membrane, rheumatism, etc. The tough fiber is known to be used locally for making ropes.

3. Root. Decoction of roots of *Gironniera* and *Trema* species mixed with other substances is used to cure sore mouth, diarrhoea, and also applied as protective medicine after child-birth.

4. Leaves. Especially of *Trema* species leaves are used as fodder, though due to the presence of glucocides they could be poisonous if consumed in a large quantity.

5. Fruits. In India fruits of *Celtis* and *Holoptelea* are known to be eaten.

6. Shade trees. *Trema* has been used for shade in coffee and cocoa plantations in various parts of Asia.

7. Soil conservation. In South Africa *Trema* has been planted to protect soils against erosion (SCHEEPERS c.s.). As both *Trema* and *Parasponia* species come up in dense seral stands on eruptiva, on fresh volcanic ash, are sometimes pioneers on lavastreams, and are almost invariably an important constituent of thickets, seral regrowths, and secondary forest, I would emphasize that they may represent an untapped cheap source for soil conservation for poor, eroded soils and old mining lands. They have all the favourable qualities of pioneer plants, indifference to soil, producing abundant seed, and that already at a very early age, and furthermore they are available almost throughout the year. Curiously I do not know of experiments by the Indonesian Forestry Service in this respect. — *Literature*: BURKILL, *Dict. Econ. Prod. Mal. Pen.* (1935) 513–514, 1088–1089, 2213–2214; METCALFE & CHALK, *Anat. Dicot.* (1950) 1277; SCHEEPERS c.s. *Tijd. Natuurwet. S. Afrika Akad. Wet. & Kunst.* 8 (1968) 105–120; SWEITZER, *J. Arn. Arb.* 52 (1971) 525.

KEY TO THE GENERA

1. Flowers always borne on bare older branches, and organized in a condensed cluster on short leafless lateral shoots; perianth cup-shaped, 5–7-lobed; ovary (fruit) stipitate. Fruit a dry, flat, winged samara. Embryo straight. 1. *Ulmus*
1. Flowers axillary, or rarely borne in a condensed capitate thyrses on older branches (*Gironniera celtidifolia*); perianth 4–5-lobed, with the lobes free from one another except for their base; ovary sessile. Fruit a fleshy drupe. Embryo variously curved.
2. Leaves triplinerved at base, or if pinnately nerved the stipules do not leave a circular scar around the node; lateral nerves less than 5 pairs. 2. *Parasponia*
3. Stipules intrapetiolar, connate
3. Stipules extrapetiolar, free.

4. Female flowers borne in condensed, multiflowered raceme. Perianth of male flower induplicate-valvate. Fruit compressed, elliptic lens-shaped in cross-section 3. *Trema*
4. Female flowers solitary in the axils of leaves or borne in a cymoid cluster of 2-3. Perianth lobes of male flowers imbricate. Fruit faintly 3-5-angular in cross-section.
5. Male flowers borne in a 2-3-flowered cymoid inflorescence or in a much-branched paniculate, subterminal inflorescence. Female flowers borne in a racemose cluster of 2-10 or in a ♂♀, much-branched racemose inflorescence; staminodes mostly present. Cotyledons broad, variously folded or curved 4. *Celtis*
5. Male flowers organized in a condensed, multiflowered raceme. Female flowers always solitary or rarely borne in a 2-3-flowered racemose, ♂♀ inflorescence; staminodes always absent. Cotyledons narrow, incurved 5. *Aphananthe*
2. Leaves pinnately nerved; lateral nerves more than 5 pairs; stipules free but overlapping each other, in falling leaving circular scar around the node 6. *Gironniera*

1. ULMUS

LINNÉ, Gen. Pl. ed. 5 (1754) 106; ENDL. Gen. Pl. (1837) 276, Suppl. 2 (1842) 29; PLANCH. Ann. Sc. Nat. III, 10 (1848) 259; in DC. Prod. 17 (1873) 154; BAILL. Hist. Pl. 6 (1877) 137; B. & H. Gen. Pl. 3 (1880) 351; HOOK. f. Fl. Br. Ind. 5 (1888) 480; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1888) 62; BERNARD, Bull. Herb. Boiss. II, 5 (1905) 1097; *ibid.* 6 (1906) 23; SCHNEIDER, Oest. Bot. Z. 66 (1916) 21, 65; in Sargent, Pl. Wils. 3 (1917) 238; GAGNEP. Fl. Gén. I.-C. 5 (1927) 674; TUTIN, Fl. Europ. 1 (1964) 65; HUTCH. Gen. Fl. Pl. 2 (1967) 147; TOUW & STEEN. Blumea 16 (1968) 84. — Fig. 2, 4-6.

Deciduous or semideciduous trees or shrubs. *Innovations* densely set with greyish to brownish simple hairs, glabrescent. Buds ovoid-conical or obovoid-globose, scales imbricate, hard and tough, glabrous. Stipules extrapetiolar, caducous. *Leaves* pinnately nerved, variously serrate to crenate, thin- to thick-coriaceous and rigid, glabrous or variously sparsely hairy at least beneath. *Flowers* ♀ but of two kinds, one functionally ♂ and the other functionally ♀, variously stalked and spirally arranged in fascicles of 3-15 on short lateral shoots. Perianth mostly campanulate, variously 4-8-lobed. Anthers glabrous, reniform, extrorse. *Ovary* compressed, sometimes stipitate; style short. Ovule 1, anatropous to amphitropous. *Fruit* a dry and compressed nutlet surrounded by a membranous reticulate-venose wing. *Seed*: endosperm absent, embryo straight with planoconvex cotyledons. Germination epigeal.

Distr. About 20-25 *spp.*, distributed in Europe (as far north as 68°), W. & SW. Russia, N. & NE. India, Burma, China, Korea, Japan, Formosa, Indo-China, N. Thailand, and in North America from N. Mexico to the U.S.A. east of the Rocky Mts as far north as 60°. In *Malesia*: 1 *sp.* so far known from a few localities in N. Sumatra, the Lesser Sunda Is. (Flores), and Central & S. Celebes.

As has been indicated by SCHNEIDER, *l.c.*, there seem to be three centres of distribution, *i.e.* the European centre (5-6 *spp.*), the Indian-E. Asian centre (10-15 *spp.*), and the North American centre (4-5 *spp.*). Fig. 3.

Fossils. Numerous fossils (pollen grains, leaf-impressions, and wood fragments) have been reported from various late Cretaceous and Tertiary deposits in Europe, Russia, China, Japan, North America, and Greenland. Fig. 3.

Ecol. In *Malesia* the genus is so far known only from areas more or less subject to a seasonal climate at 200-1450 m.

Taxon. Currently there is not a single worldwide monograph of the genus available for reference. The latest and perhaps the most comprehensive revision since PLANCHON's work (1873) is that by SCHNEIDER (1916). He distinguished 26 *spp.* and recognized 5 distinct sections in the genus based on morphological characters derived from inflorescence, flowers, and fruits.

When more specimens from China become available for further studies, I believe the number of species occurring in the Indian-E. Asian centre will have to be reduced considerably.

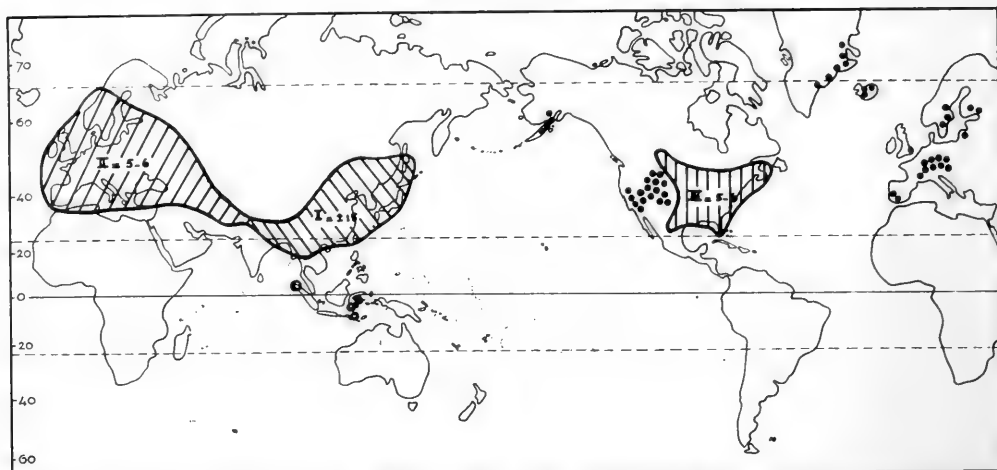


Fig. 3. Approximate range of *Ulmus* L. with number of *spp.* in each of the three centres, Malaysian localities belonging to a species of the Asian centre. Fossil localities outside the present range indicated by dots; adopted from BERNARD, *l.c.*; GREGUSS (Tert. Angios. Hung., Ak. Kiado Budapest, 1969, 83), and LA MOTTE (Mem. Geol. Soc. Am. 51, 1952, 346).



Fig. 4. Peeling bark of *Ulmus lanceaeifolia* ROXB. ex WALL., $\times \frac{1}{8}$ (Photogr. SCHMUTZ, 5 Nov. 1972, Flores, Nunang).

1. *Ulmus lanceaeifolia* ROXB. ex WALL. Pl. As. Rar. 2 (1831) 86, t. 200; ROXB. Fl. Ind. ed. Carey 2 (1832) 66 ('*lanceifolia*'); PLANCH. Ann. Sc. Nat. III, 10 (1848) 281; in DC. Prod. 17 (1873) 162; KURZ, For. Fl. Burma 2 (1877) 473; GAMBLE, Man. Ind. Timb. ed. 1 (1881) 342; HOOK. f. Fl. Br. Ind. 5 (1888) 480; HEMSL. J. Linn. Soc. Bot. 26 (1894) 447; PRAIN, Beng. Pl. (1903) 718; BRANDIS, Ind. Trees (1906) 594; SCHNEIDER, Oest. Bot. Z. 66 (1916) 32; in Sargent, Pl. Wils. 3 (1917) 263; MERR. Contr. Arn. Arb. 8 (1934) 44; TOUW & STEEN. Blumea 16 (1968) 84; MELVILLE & HEYBROEK, Kew Bull. 26 (1971) 24 ('*lanceifolia*'). — *U. hookeriana* PLANCH. in DC. Prod. 17 (1873) 162; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1888) 62. — *U. tonkinensis* GAGNEP. Fl. Gén. I.-C. 5 (1927) 674. — Fig. 2, 4-6.

Small to large tree up to 48 m, 70 cm \varnothing , often with fluted trunk. Bark rough, pustulate, with large warty lenticels. Branchlets initially densely set with greyish to brownish curly simple hairs, later glabrous and sparsely warty lenticellate. Buds obovoid-globose, c. 2-3 mm \varnothing ; bracts dark brown. Stipules linear-lanceolate acute, c. 4-5 by 1-1½ mm, soon caducous. Leaves thin- to thick-coriaceous, lanceolate to ovate-lanceolate, (2-)4-6(-9) by (1-)2-3 (-3½) cm (index 2-2½), broadest at or slightly below the middle, more or less glabrous, glossy; base rounded to attenuate-acute, unequal; margin serrulate to serrulate-crenulate; apex acute with blunt tip; midrib raised beneath and flattish to impressed above, as the petiole initially densely greyish, curly hairy on both surfaces, glabrescent; nerves (6-)10-12(-14) pairs, subparallel, often rather irregularly spaced, slightly raised beneath, flattish to impressed above, often forked near and towards the leaf-margin; reticulations fine, areolate; petiole (2-)3-4(-6) by ½-1 mm. Flowers in fascicles of 3-10. — Functionally δ flowers globose before anthesis, 1½-2 mm \varnothing , subglabrous; lobes 5-6, obovate-lanceolate, c. 2 by 1 mm; filaments



Fig. 5. *Ulmus lanceaefolia* ROXB. ex WALL. with old leaves at Nunang (Photogr. SCHMUTZ, 15 Oct. 1972, Flores).

glabrous, slender, c. 1 mm; anthers c. 1 by $1\frac{1}{2}$ mm, glabrous; pistillode compressed obovate-elliptic, glabrous. — Functionally ♀ flowers (as seen under a very young fruit): perianth campanulate, lobes 5–6, rounded-elliptic, hairy along the margin; filaments slender, glabrous, 3–5 mm, anthers as in ♂ flower; ovary stipitate, glabrous, \pm obovate-elliptic. Fruit obovate-elliptic, glabrous, including the wing $2-3\frac{1}{2}$ by $1\frac{1}{2}-2$ cm, stalk 5–10 mm, articulate, lower part hairy.

Distr. China (?), India (E. Himalaya, Sikkim, Bhutan, Khasia Hills, Manipur, Assam), Bangladesh, Burma (Hukong Valley, Chittagong Hills), Thailand (northern parts), Laos, Vietnam (Mt Bavi); in Malesia: N. Sumatra (Gajo- & Karo-Batak Lands), Lesser Sunda Is. (Flores), and Celebes (Poso; Bonthain). Fig. 7.

Ecol. Scattered tree in lowland to submontane forest, 200–1450 m. In Thailand it is confined to forests along streams and in Flores it has been found on limestone. Fl. fr. in the northern hemisphere Febr.–April; in Flores Nov.

Taxon. *U. lanceaefolia* is very closely allied to *U. parvifolia* JACQ. from China and Japan. It differs from the latter by its narrow leaves with a shorter petiole, serrulate to serrulate-crenulate margin, and fewer lateral nerves, obovoid-globose buds, the campanulate perianth of the functionally ♀ flower, and the reticulate venation of the fruit; see fig. 2.

Uses. Very little is known about the usage of this species, but judging from the enormous size it can attain it must have been a useful timber in house-building, construction, etc., at least to the local inhabitants.

Vern. Sumatra: *pěngki(h)*, *poki*, Karo-Batak, *pongki*, Toba-Batak; Lesser Sunda Is.: *ngguling*, *ngguling*, Flores; Celebes: *mota*, Bonthain.



Fig. 6. *Ulmus lanceaefolia* ROXB. ex WALL., leafless, in flower, $\pm \times \frac{2}{3}$, at Nunang (Photogr. SCHMUTZ, 5 Nov. 1972, Flores).

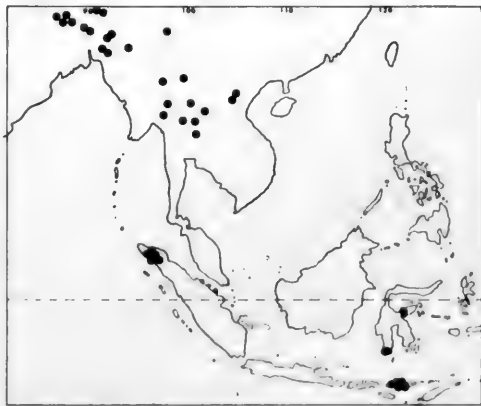


Fig. 7. Range of *Ulmus lanceaefolia* ROXB. ex WALL.

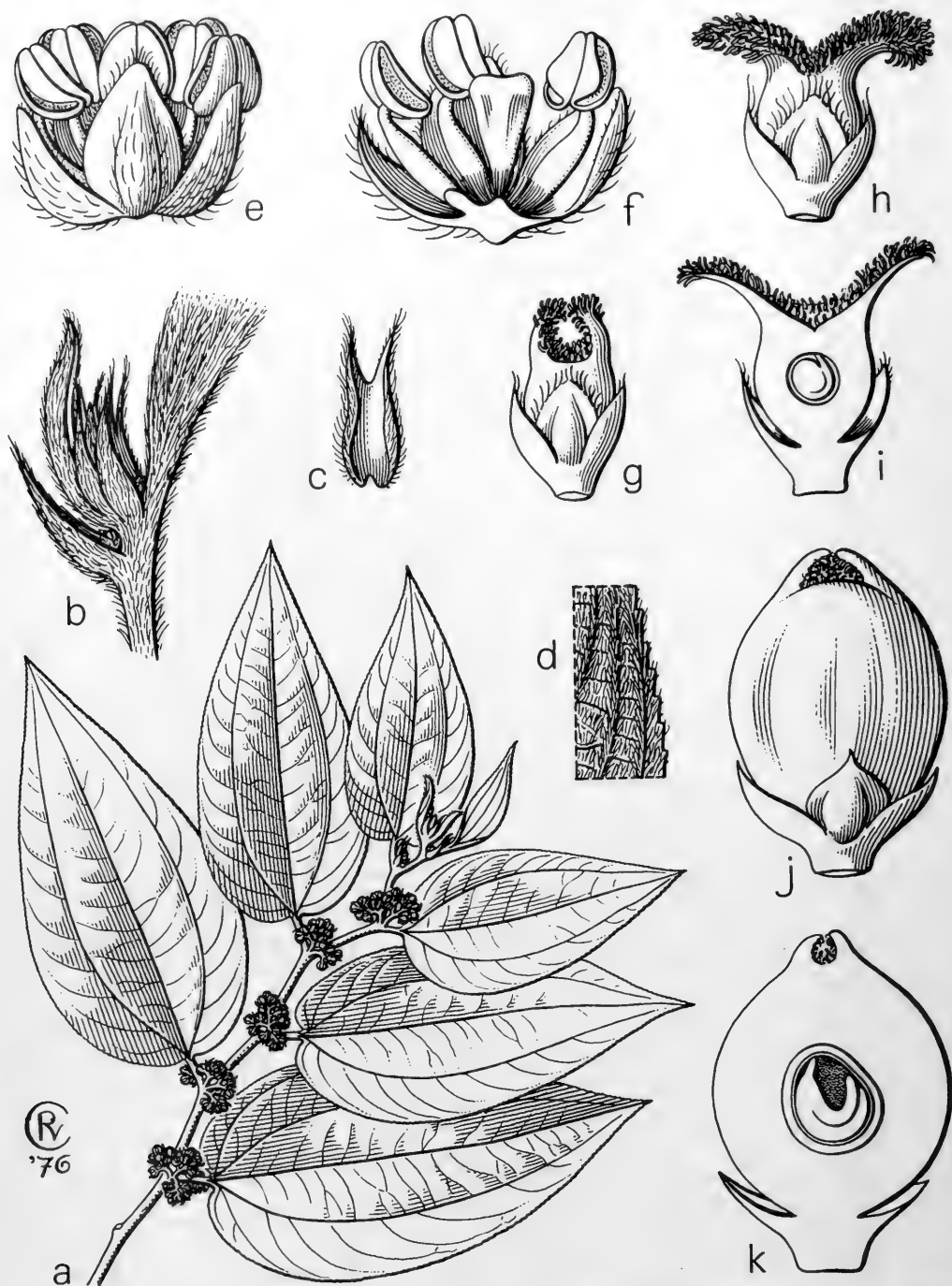


Fig. 8. *Parasponia rigida* MERR. & PERRY. a. Habit, $\times \frac{2}{3}$, b. twig-tip with stipules, c. connate stipules, from inside, d. detail of leaf undersurface, all $\times 3$, e. ♂ flower, f. ditto in LS. g. young ♀ flower, h. mature ♀ flower, i. ditto in LS, all $\times 12$, j. fruit, k. ditto in LS, both $\times 12$ (a-f ANU 6463, g-k SCHODDE 4828).

2. PARASPONIA

MIQ. Pl. Jungh. (1851) 68; Fl. Ind. Bat. 1, 2 (1859) 218; BL. Mus. Bot. 2 (1856) 65; PLANCH. in DC. Prod. 17 (1873) 194; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1888) 65; J. J. SMITH in K. & V. Bijdr. 12 (1910) 662; BACK. & BAKH. f. Fl. Java 2 (1965) 12; HUTCH. Gen. Fl. Pl. 2 (1967) 149. — Fig. 8, 10–11.

Shrubs to medium-sized trees. Bark grey-brown, smooth to finely fissured; inner bark fibrous and tough. *Innovations* with dense appressed, silvery to greyish hairs. Stipules intrapetiolar, connate into a bifurcate unit and together enclosing the terminal bud, caducous. *Leaves* (in Mal.) triplinerved at base, concolorous, above non-scabrous to variously scabrous, mostly glabrous except for the midrib and lateral nerves, lower surface variously pubescent. *Inflorescences* axillary, ♂, ♀, or ♂♀, much-branched, many-flowered, paniculate or thyrsoid, including the bracts densely short greyish appressed-pubescent. Flowers 5-merous. — ♂ *Flower* ± globose, perianth lobes imbricate in bud; stamens glabrous, introrse; filaments subulate, glabrous; anthers reniform to subglobose, sub-basifixed, glabrous; pistilode obovoid-conical, compressed, surrounded by hirsute hairs at its base. — ♀ *Flower* ovoid-conical; staminodes absent; ovary ovoid, slightly compressed; stigmatic arms short, simple; ovule anatropous. *Drupe* ovoid, slightly compressed pericarp fleshy and fibrous, endocarp hard and stony. *Seed*: endosperm scanty or copious; embryo curved, cotyledons equal, hypocotyle ascending.

Distr. 5 spp., in Polynesia (Tahiti) and Melanesia (Fiji, New Hebrides, Solomons); in *Malesia*: New Guinea (incl. New Britain), Moluccas (Ternate, Banda), Philippines, Celebes, Lesser Sunda Is. (Lombok, Bali), Java, and S. Sumatra (Palembang). Fig. 9, 12.

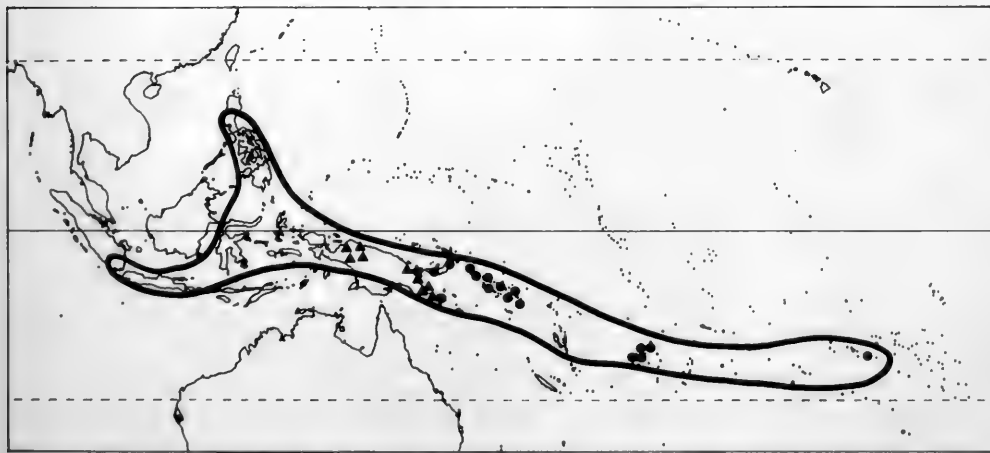


Fig. 9. Approximate range of the genus *Parasponia* MIQ. (line); localities of *P. andersonii* (PLANCH.) PLANCH. (dots) and *P. melastomatifolia* J. J. S. (triangles).

Ecol. In New Guinea and the Pacific islands the genus is found as a pioneer plant invading and occupying newly available habitats from the lowland up to 2000 m. In Java the same situation was described by E. W. CLASON from natural regeneration on volcanic ash of Mt Kelud, together with *Trema* (Bull. Jard. Bot. Btzg III, 13, 1935, 509). Fig. 10, 11. Recorded as a pioneer on lavastreams of Mt Batur in Bali by DE VOOGE (Trop. Natuur 29, 1940, 48, f. 12). Grows well in all types of soils, including volcanic ash and limestone, very often gregariously together with *Trema* spp. and forming a dense thicket on ridges, hills and along river-banks.

TAXON. *Parasponia* is morphologically very similar to *Trema* but can easily be distinguished from the latter by its imbricate perianth lobes of the male flowers and intrapetiolar, connate stipules enclosing the terminal bud.

KEY TO THE SPECIES

1. Basal nerves running up throughout the length of the leaf or nearly so.
2. Leaf thick-coriaceous, lower surface densely set with soft erect hairs; margin distinctly serrate; reticulations prominent beneath. Inflorescence ♂ or ♀, at anthesis condensed and shorter than the petiole. **1. *P. rigida***
2. Leaf chartaceous to thin-coriaceous, lower surface glabrous or sparsely appressed-hairy; margin finely serrulate to subentire; reticulations obscure. Inflorescence ♂ or ♂♀, at anthesis lax and longer than the petiole. **2. *P. melastomatifolia***
1. Basal nerves running up to $\frac{1}{2}$ – $\frac{2}{3}$ the length of the leaf.
3. Leaf thick-coriaceous, upper surface strongly rugose and scabrous, lower surface densely pubescent; midrib, nerves, and reticulations prominent beneath. **3. *P. rugosa***
3. Leaf chartaceous to thin-coriaceous, upper surface not or hardly rugose nor scabrous, lower surface sparsely appressed pubescent or glabrous; midrib, nerves, and reticulations only slightly raised beneath.
4. Leaf elliptic-lanceolate, more or less glabrous; nerves more than 4 on each side, straight and ascending at a narrow angle (less than 40°) from the midrib. Inflorescences mostly ♂♀, very rarely ♂ or ♀. **4. *P. parviflora***
4. Leaves ovate to ovate-elliptic, underneath sparsely appressed pubescent; nerves less than 4, usually 3 on each side, arcuating at a wider angle (c. 45–60°) from the midrib. Inflorescences ♂ or ♀, rarely ♂♀. **5. *P. andersonii***

1. *Parasponia rigida* MERR. & PERRY, J. AGN. Arb. 22 (1941) 254. — Fig. 8.

Small tree, up to 10 m, 10 cm Ø. Branchlets initially densely silver-appressed-hairy, glabrescent and sparsely warty lenticellate. Stipules ovate-lanceolate, 8–10 by 2–3 mm. Leaves elliptic to ovate-lanceolate, thick-coriaceous, (5–)8–10(–12) by $(1\frac{1}{2}$ –)2–3 $\frac{1}{2}$ (–4 $\frac{1}{2}$) cm (index 2 $\frac{1}{2}$ –3 $\frac{1}{2}$), broadest at or below the middle; base rounded to subcordate, mostly symmetrical; margin serrate; apex acute to acuminate; above more or less glabrous, rugulose and scabrous, beneath densely soft-hairy; midrib and nerves strongly raised beneath, flattish to impressed above; reticulations subscalariform, distinct beneath; petiole 10–12 by 2–3 mm, terete. Inflorescences ♂ or ♀, very rarely ♂♀, 10–50-flowered, at anthesis condensed, c. $\frac{1}{2}$ –1 cm long, usually shorter than the petiole. — ♂ Flowers 1–2 mm Ø, perianth lobes narrow-ovate, concave, c. 2 by 1 mm, appressed-pubescent outside; filaments c. 1 mm; anthers ellipsoid, c. 1 by $\frac{1}{2}$ mm, pistillode obovoid-conical, c. 1 by $\frac{1}{2}$ mm. — ♀ Flower ovoid, c. 2 by 1 mm; perianth lobes ovate-acute, c. $\frac{3}{4}$ by $\frac{1}{2}$ mm, sparsely pubescent outside; ovary c. 2 by 1 mm, stigmatic arms spreading, long-papillose, c. $\frac{1}{2}$ –1 mm. Drupe ovoid-globose, c. 3–4 mm Ø, turning orange to red when ripe. Endosperm copious.

Distr. *Malesia*: New Guinea. Fig. 12.

Ecol. Dominant pioneer tree in secondary vegetation on ridges, also in mossy forest and on limestone hills, 1000–2000 m. Fl. fr. Jan.–Dec.

Vern. *Bésukan*, Hattam lang., *golan*, Finschhafen dial., Morobe Distr.

2. *Parasponia melastomatifolia* J. J. SMITH, Nova Guinea 8, 2 (1914) 891, t. 158. — *P. similans* MERR. & PERRY, J. Arn. Arb. 22 (1941) 255.

Shrub to small tree, up to 6 m, with spreading and brittle branches. Branchlets initially densely appressed-silvery-hairy, glabrescent and sparsely lenticellate. Stipules ovate-elliptic, 4–5 by 2–3 mm. Leaves elliptic-lanceolate to ovate-elliptic, (5–)6–8

(–10) by $(1\frac{1}{2}$ –)2 $\frac{1}{2}$ –3 $\frac{1}{2}$ (–4 $\frac{1}{2}$) cm (index 2–3), broadest at or slightly below the middle; chartaceous to thin-coriaceous, above more or less glabrous, hardly scabrous and often with mineral deposits on the epidermis, beneath sparsely appressed-hairy especially on midrib and nerves, or completely glabrous; base more or less rounded, symmetrical; margin finely serrulate to ± entire; apex acute; midrib and nerves slightly raised beneath, flattish to impressed above; nerves 1–2 pairs, the basal ones running throughout the length of the leaf or nearly so, at an acute angle of less than 45°; reticulations subscalariform, inconspicuous on both surfaces; petiole (5–)8–12(–15) by 1 mm, sulcate, sparsely appressed-pubescent. Inflorescences ♂ or ♂♀, paniculate, 10–20-flowered, at anthesis lax, 2–3 cm long and across, axes c. 1 mm Ø, densely appressed-pubescent; bracts ovate, c. $\frac{1}{2}$ by 1 mm, sparsely appressed-pubescent outside. — ♂ Flowers c. 1–2 mm Ø, perianth lobes ovate-acute, c. $\frac{1}{2}$ –1 by $\frac{1}{2}$ mm, sparsely appressed-hairy outside; filaments c. 1 mm, anther subglobose, c. 1 by $\frac{1}{2}$ mm, pistillode obovoid, c. $\frac{1}{2}$ –1 by $\frac{1}{2}$ mm. — ♀ Flower ovoid, c. 1–2 by 1 mm; perianth lobes ovate-acute, c. $\frac{1}{2}$ –1 by $\frac{1}{4}$ – $\frac{1}{2}$ mm, sparsely appressed-hairy outside; ovary ovoid, c. 2 by 1 mm; stigmatic arms c. 1 mm, incurved. Drupe ovoid-globose, c. 3 by 2 mm. Endosperm scanty.

Distr. *Malesia*: New Guinea. Fig. 9.

Ecol. Common and dominant in seral vegetation in gullies and river-banks, 200–1000 m. Fl. fr. Jan.–Dec.

Vern. *Kwatoro*, Onjob lang., Northern Distr., E. New Guinea.

3. *Parasponia rugosa* BL. Mus. Bot. 2 (1856) 66. — *P. aspera* BL. l.c. 66; MIQ. Fl. Ind. Bat. 1, 2 (1859) 218. — *Trema vulcanica* MERR. Philip. J. Sc. 7 (1912) Bot. 260. — *Trema philippinensis* ELMER, Leaf. Philip. Bot. 9 (1934) 3218. — *P. parviflora* (non MIQ.) STEEN. Philip. J. Sc. 91 (1962) 507. — Fig. 10–11.

Shrub or medium-sized tree, up to 20 m, 30 cm \varnothing , with spreading branches. Bark smooth, grey-brown; inner bark tough, brownish. Branchlets densely, silvery, appressed, long-hairy, subglabrescent. Stipules ovate-lanceolate, (6-)8(-10) by 2-3 mm. Leaves ovate-lanceolate, (7-)8-10(-12) by (2-)2 $\frac{1}{2}$ -3 $\frac{1}{2}$ (-5) cm (index 2 $\frac{1}{2}$ -3), broadest at or below the middle, thick-coriaceous; above rugose and scabrous, sparsely hairy especially on midrib and nerves, beneath densely silvery hairy by soft, erect hairs; base rounded to cordate, equal to slightly unequal; margin serrate, apex acute to acuminate, the acumen up to 2 cm; midrib and nerves strongly raised and prominent beneath, flattish to impressed above; nerves 2-4 pairs, arcuate and ascending, the basal ones running up to $\frac{1}{2}$ - $\frac{2}{3}$ the length of the leaf; reticulations dense, areolate, prominent beneath; petiole 7-10 by 2-3 mm, subterete, densely appressed-pubescent. Inflorescences σ or $\sigma\sigma$, 10-50-flowered, densely silvery appressed-hairy, at anthesis condensed, axes c. $\frac{1}{2}$ -1 $\frac{1}{2}$ cm long, 1-2 mm \varnothing ; bracts ovate-acute, c. 1 $\frac{1}{2}$ -1 mm. — σ Flower c. 1-2 mm \varnothing ; perianth lobes ovate-acute, c. 1-2 by 1 mm, sparsely hairy outside; filaments 1-1 $\frac{1}{2}$ mm, anthers ovoid-reniform, c. 1 mm \varnothing ; pistillode ovoid, compressed, c. 1-2 by 1 mm. — φ Flower ovoid-conical, c. 1-1 $\frac{1}{2}$ by 1 mm; perianth lobes narrow ovate-acute, c. 1-1 $\frac{1}{2}$ by 1 mm, sparsely appressed-hairy outside; ovary ovoid, c. 1-2 by 1 mm, stigmatic arms c. 1 mm, spreading. Drupe ovoid, 2-3 by 2 mm, turning red when ripe. Endosperm copious.

Distr. *Malesia*: East Java (Mts Kelud & Lamongan), Lesser Sunda Is. (Bali, Lombok), Philippines (Luzon, Leyte, Mindanao), Celebes (near Makassar; Tondano, Manado), Moluccas (Ternate, Banda), New Guinea (W. & E. Highlands and Morobe Distr., incl. New Britain). Fig. 12.



Fig. 10. Pioneer vegetation on the volcanic ash of Mt Kelud, East Java, of *Saccharum spontaneum* and *Parasponia rugosa* BL. (Photogr. CLASON).

Ecol. Rather common and often dominant or co-dominant pioneer plant in seral vegetation on various types of soils including volcanic ash, 50-1900 m. Fl. fr. Jan.-Dec. Fig. 10, 11.

Uses. Strips of the inner bark are used as ropes in house and fence building by local inhabitants.

Vern. Java: *anggring*, *anggris*, J; Philippines: *analdung*, If.; Moluccas: *kayu kuli*, Banda; New Guinea: *wanep*, Enga lang., W. Highlands Distr., *la karabi*, W. Nakanai, New Britain.

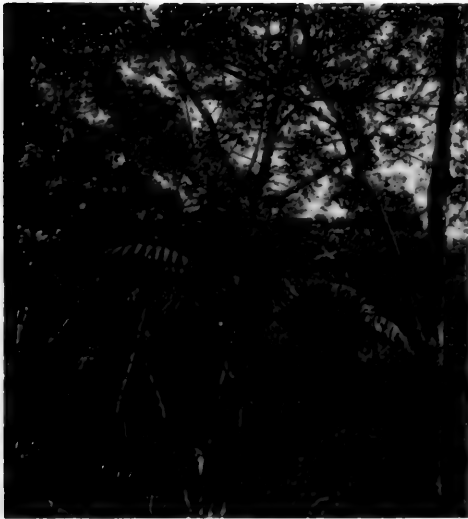


Fig. 11. Older pioneer forest on Mt Kelud of *Parasponia rugosa* BL., *Trema*, *Cyathea contaminans*, and *Amomum* (Photogr. CLASON).

4. *Parasponia parviflora* MIQ. Pl. Jungh. (1851) 69; Fl. Ind. Bat. 1, 2 (1859) 218, t. 16; BL. Mus. Bot. 2 (1856) 65, f. 35; PLANCH. in DC. Prod. 17 (1873) 194; J. J. SMITH in K. & V. Bijdr. 12 (1910) 663, p.p. excl. syn. *P. aspera* BL.; BACK. & BAKH. f. Fl. Java 2 (1965) 12. — *P. similis* BL. Mus. Bot. 2 (1856) 66.

Small to medium-sized tree, up to 15 m. Branchlets initially densely silvery or grey appressed-hairy, glabrescent, smooth. Stipules ovate, 5–10 by 2–4 mm, sparsely hairy outside. *Leaves* lanceolate to narrow ovate-lanceolate, (3–)5–8(–10) by (1–)2–3(–3½) cm (index 3–4), broadest at or below the middle; chartaceous to thin-coriaceous, above ± glabrous, not scabrous, beneath initially appressed-hairy, later glabrous except for the midrib and nerves; base rounded, more or less equal; margin finely serrate, apex acute; midrib and nerves slightly raised beneath, impressed and inconspicuous above; nerves 4–6 pairs, straight, ascending and parallel, at a narrow angle (30–40°), basal ones running up to ± half the length of the leaf; reticulations fine, subscalariform, indistinct on both surfaces; petiole terete, densely appressed-hairy, 5–10 by 1 mm. *Inflorescences* ♂, ♀, or ♂♀, 5–30-flowered, at anthesis condensed, shorter than or as long as the petiole, as the bracts densely short-hairy; bracts ovate-acute, 1–1½ by ½–1 mm. — ♂ *Flowers* glabrous, 1–2 mm Ø; perianth lobes c. 1–1½ by ½ mm; filaments ½–1 mm, anthers subglobular, c. 1 by ½ mm; pistillode ovoid-conical, compressed, 1–1½ by ½ mm. — ♀ *Flowers* ovoid-conical, c. 2 by 1½ mm, ± glabrous except for the inner base of the perianth lobes; perianth lobes ovate-acute, c. 1 by ½ mm; ovary ovoid, c. 1½ by 1 mm; stigmatic arms spreading, c. ½–1 mm. *Drupe* ovoid-conical, slightly compressed, 1½–2 by 1½ mm. Endosperm scanty.

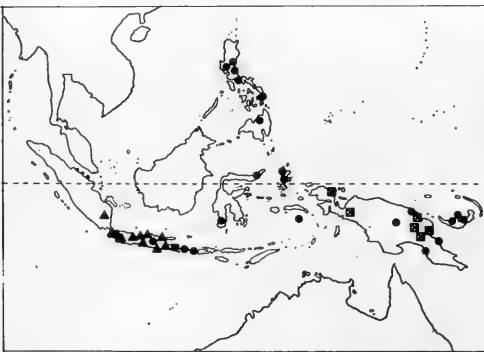


Fig. 12. Localities of *Parasponia rugosa* BL. (dots), *P. parviflora* MIQ. (triangles), and *P. rigida* MERR. & PERRY (squares).

Distr. *Malesia*: S. Sumatra (Palembang, very rare), Java (common). Fig. 12.

Ecol. In secondary or seral vegetation on exposed habitats, also in teak forest, often rather common and dominant locally especially on soils derived from volcanic ash, 500–2000 m. *Fl. fr.* Jan.–Dec.

Vern. Kurai, k. lèlaki, k. tjangkrèng, S, anggring, angrgis, anggrung, J.

5. *Parasponia andersonii* (PLANCH.) PLANCH. in DC. Prod. 17 (1873) 193. — *Sponia andersonii* PLANCH. Ann. Sc. Nat. III, 10 (1848) 336; SEEMANN, Fl. Vit. (1867) 235; PARHAM, Pl. Fiji Isl. (1972) 133. — *P. paucinervia* MERR. & PERRY, J. Arn. Arb. 20 (1939) 324.

Shrub to medium-sized tree, up to 15 m and 30 cm Ø. Branches spreading and drooping, initially densely set with erect but soft, silvery hairs, subglabrescent and sparsely warty lenticellate. Bark smooth to nodular, grey-brown; inner bark fibrous, tough, orange to brownish. Stipules ovate-acute, sparsely hairy outside, 6–10 by 3–4 mm. *Leaves* ovate to elliptic, thin-coriaceous, (5–)8–12(–14) by (2–)3–4(–6) cm (index 2–3), broadest below or at the middle; above subglabrous, scabrous, often covered with mineral deposits, beneath sparsely set (rarely rather densely) with short and soft hairs especially on midrib and nerves; base rounded to subcordate, equal, rarely unequal; margin serrate, apex acute to acuminate; midrib and nerves slightly raised beneath and impressed above; nerves 3–4 pairs, arcuating and ascending at an angle of 45–60°, basal extending up to c. 2/3 the length of the leaf; reticulations fine, subscalariform, rather distinct below; petiole (7–)10–15(–20) by 1–2 mm, densely set with silvery, soft, erect hairs, flat or sulcate. *Inflorescences* ♂, ♀, or rarely ♂♀, 10–30-flowered, at anthesis condensed or lax, shorter than or as long as the petiole, including the bracts densely silvery, soft-hairy; bracts ovate-acute, c. 1 by ½ mm. — ♂ *Flowers* c. 1½–2 mm Ø; perianth lobes ovate-elliptic, c. 1 by ½ mm; stamens glabrous; filaments c. 1 mm, anthers subreniform to subglobular, c. 1 by ½ mm; pistillode subovoid-conical, c. 1½ by ½ mm. — ♀ *Flowers* ovoid-ellipsoid, c. 1½ by 1 mm; perianth lobes ovate-acute, c. 1 by ½ mm; ovary ovoid, slightly compressed, c. 1 by ½ mm; stigmatic arms c. ½ mm, spreading and short-papillose. *Drupe* ovoid, slightly compressed, 2–4 by 2–3 mm. Endosperm copious.

Distr. Polynesia (Tahiti), Melanesia (Fiji, New Hebrides, Solomons, very common), ? New Caledonia (no specimen seen but cf. GUILLAUMIN, Fl. Nouv.-Caléd. 1948, 94); in *Malesia*: New Guinea (several islands off Madang and Milne Bay) and New Britain. Fig. 9.

Ecol. Primary as well as secondary forests, on various types of soils including limestone, 0–1500 m. *Fl. fr.* Jan.–Dec.

Uses. In the Solomons the bark is reputed to have medicinal properties.

Vern. New Britain: *ip*, *ivu*; Solomons: *bulusisi*, *bulsisi*, Kwara lang.; Fiji: *ndroi*, *ndrou*.

3. TREMA

LOUR. Fl. Coch. 2 (1790) 562; BL. Mus. Bot. 2 (1856) 58; BTH. Fl. Austr. 6 (1873) 157; B. & H. Gen. Pl. 3 (1880) 355; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1888) 65; BERNARD, Bull. Herb. Boiss. II, 6 (1906) 31, maps 19–21; J. J. SMITH in K. & V. Bijdr. 12 (1910) 649; RENDLE, Fl. Trop. Afr. 6, 2 (1917) 10; DE WIT, Bull. Bot. Gard. Btzg III, 18 (1949) 184; HUTCH. Gen. Fl. Pl. 2 (1967) 148; ELIAS, J. Arn. Arb. 51 (1970) 37, f. 2; SOEPADMO in Whitmore, Tree Fl. Mal. 2 (1973) 420. — *Sponia* COMMERS. ex LAMK, Dict. 4 (1795) 138; ENDL. Gen. Pl. 4 (1837) 276; PLANCH. Ann. Sc. Nat. III, 10 (1848) 264; in DC. Prod. 17 (1873) 195. — **Fig. 13, 16–17.**

Trees or shrubs, often buttressed and with spreading and drooping branches, monoecious. *Innovations* variously and densely set with simple bulbous-based hairs or/and with short multicellular capitate-glandular hairs. Terminal buds ovoid-conical, enclosed by overlapping but free extrapetiolar, caducous stipules. *Leaves* penninerved; above \pm glabrous, variously scabrate, beneath glabrous, subglabrous, or variously densely set with bulbous-based hairs and/or with short multicellular glandular hairs; base triplinerved, cordate to acute, often unequal-sided; margin variously serrate or denticulate; apex acute to acuminate or caudate; petiole sulcate. *Inflorescence* axillary, paniculate or thyrsoid, many-flowered, condensed or lax at anthesis, ♂, ♀, ♂♀, densely and variously pubescent; bracts minute, ovate-acute, caducous. — ♂ *Flower* globular; perianth 4–5-lobed, lobes induplicate-valvate in bud, boat-shaped; stamens glabrous, introrse; filament subulate, glabrous, incurved in bud; anthers subglobular to reniform, glabrous, dorsifixed near the base; pistillode present, hirsute at base. — ♀ *Flower* ovoid; perianth 4–5-lobed; staminodes absent or very rarely present; ovary ovoid, (in Mal.) glabrous, slightly compressed, sessile; style short; ovule ana- to amphitropous. *Drupe* ovoid or subglobose, (in Mal.) slightly compressed, glabrous; exocarp fleshy and fibrous, endocarp stony and very hard. *Seed* with a rather scanty or copious endosperm; embryo curved or nearly involute; hypocotyle ascending; cotyledons equal. Germination epigeal.

Distr. About 10–15 *spp.*, widely distributed throughout the tropics and subtropics. In Asia (with 6–7 *spp.*) from the warmer parts of the Himalayas, extending north-eastwards to China (incl. Hainan, Hong-kong, Formosa) and S. Japan and south and south-eastwards through India, Burma, Thailand, Indo-China, and Malesia to the tropical and subtropical parts of Australia and the Pacific islands as far east as Tahiti (31° N–37° S). In Africa (with 3–4 *spp.*) it occurs south of the Sahara to S. Africa and Madagascar (22° N–28° S). In America (with 4–5 *spp.*) the genus is known from Central & S. Florida and Mexico, extending south-eastwards through Central America, Bermuda, and the Bahamas, the Greater Antilles and southwards to South America as far south as the northern parts of Argentina (26° N–25° S). In *Malesia*: 4 *spp.*, widely spread. Fig. 14, 15.

Ecol. Throughout its range of distribution the genus seems to grow well and often gregariously in newly opened up habitats on various types of soils ranging from heavy laterite to limestone soils and soils derived from volcanic ash (fig. 17), from sea-level up to 2000 m.

Pollination is probably affected by wind and small insects.

The fruits which turn orange, red or black when ripe are dispersed by various species of bulbuls.

In East Java CLASON (Bull. Jard. Bot. Btzg III, 13, 1935, 509, f. III) reported that following the frequent eruptions of Mt Kelud, *Trema* *spp.* together with *Parasponia* *spp.* formed a dominant association in the regrowths on volcanic ash.

Taxon. The genus is homogeneous and closely related to *Parasponia* and *Celtis*. This is corroborated by the anatomy of the wood and leaves. Reports on the cytology are, however, suggesting that the number of chromosomes is not constant.

Embryology. Very little is known about the sporogenesis and embryogenesis of the genus. A preliminary study carried out recently on *Trema cannabina* and *T. tomentosa* in the Malay Peninsula indicates that the development of the anther and microspores follow the so-called dicotyledon-type, and that of the embryo-sac conforms with the *Polygonum*-type.

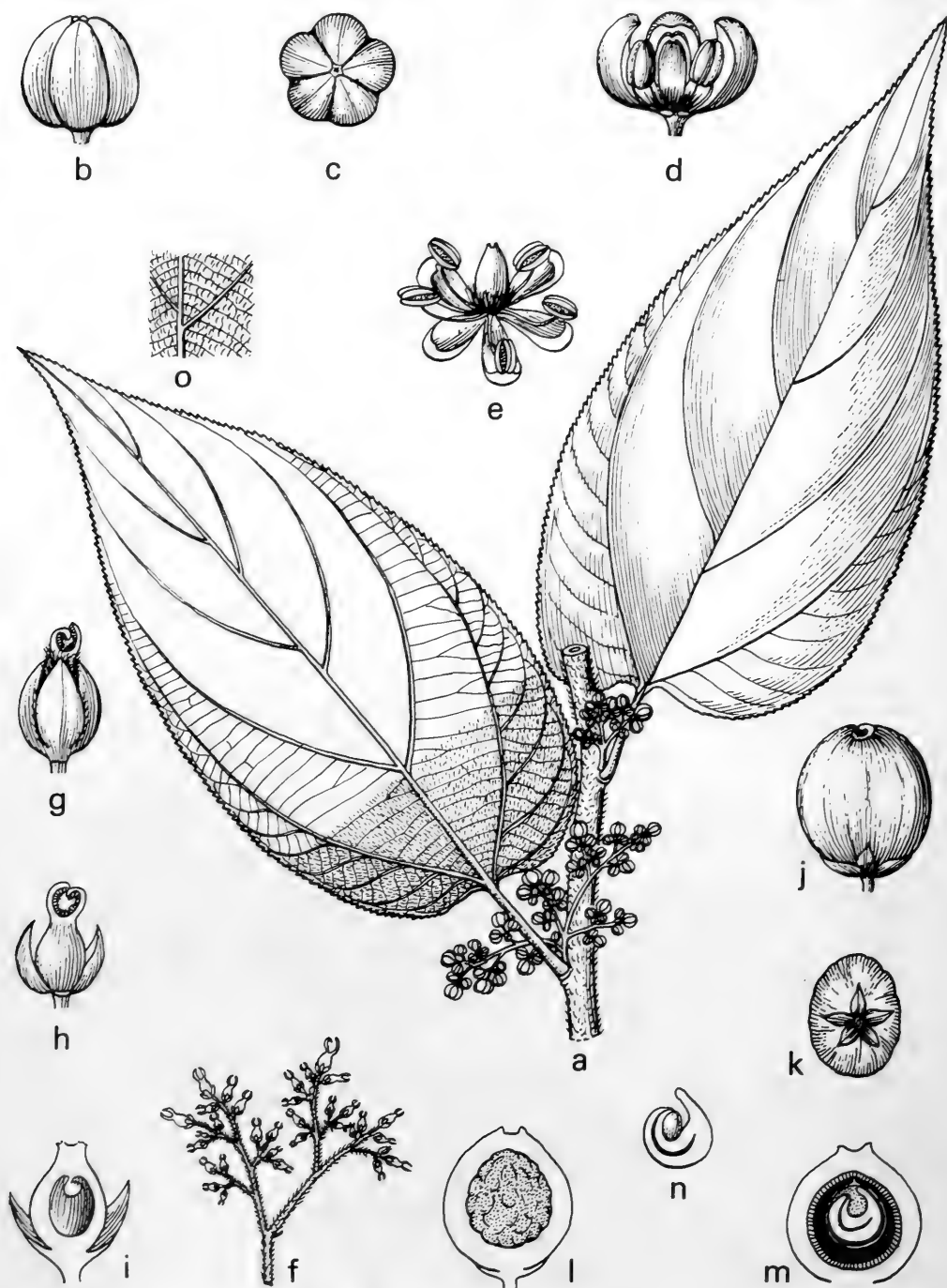


Fig. 13. *Trema orientalis* (L.) Bl. a. Habit, with functionally ♂ flowers, $\times \frac{2}{3}$, b-e. ♂ flowers at various stages of development, all $\times 8$, f. ♀ inflorescence, $\times \frac{2}{3}$, g. ♀ flower, h. older ♀ flower, 2 tepals removed, i. ditto in LS, j-k. mature fruit, l. ditto, exocarp halfway removed, showing stone, m. ditto in LS, n. embryo, o. detail of lower leaf surface, all $\times 8$ (a-e BW 13889, f-i BW 7019, j-n BRASS 6496).

In absence of a critical, reliable world monograph there is a similar uncertainty about the number of species in the neotropics and in Indo-Malesia. For Malesia out of 20–25 published names of species and varieties, only 4 *spp.* are recognized here.

The proliferation of name giving in Malesia is mainly due to the fact that *Trema spp.* have a growth habit of continuously producing lateral and terminal new shoots on which flowers and fruits are borne. Many specimens collected were from these young shoots in which the indumentum and leaf-shape is often different from that of mature leaves. For accurate identification leaves, inflorescences, and fruits of mature specimens are essential. Besides, the indumentum was in earlier descriptions mostly derived from low magnification observations, but to differentiate sterile material of *T. orientalis* and *T. tomentosa* the difference in the indumentum becomes only clear under at least 40 × magnification. It is impossible to name young sterile specimens.

KEY TO THE SPECIES

(Based on mature leaves, inflorescences, and fruits)

1. Petiole (7–)10–15(–25) mm. Leaves broad ovate-elliptic, rarely narrow lanceolate (but then either glabrous or silvery brown tomentose beneath), (3–)5–10(–13) by (1¹/₂–)2–4(–5¹/₂) cm (and then glabrous or sparsely pubescent beneath) or (5–)10–15(–19) by (2–)3–7(–10) cm. Inflorescence ♂, ♀, or ♂♀, at anthesis lax, 10–100-flowered, 1¹/₂–5 cm long. Mature fruit 3–5 by 2–4 mm.
 2. Leaves (3–)5–10(–13) by (1¹/₂–)2–4(–5¹/₂) cm, glabrous or rarely sparsely pubescent beneath, chartaceous to thin-coriaceous; base rounded, rounded-attenuate, truncate, or very rarely subcordate, mostly symmetrical; nerves 2–4(–5) pairs. Inflorescence always with a slender axis. Mature fruit c. 3 by 2 mm, orange or red in colour 1. *T. cannabina*
 2. Leaves (5–)10–15(–19) by (2–)3–7(–10) cm, densely and variously hairy beneath, thin- to thick-coriaceous; base cordate, subcordate or rounded, mostly asymmetrical; nerves 4–8 pairs. Inflorescence with a stout or slender axis. Mature fruit black, 3–5 by 3–4 mm.
 3. Leaves beneath (fig. 16) completely covered with matted glaucous to silvery straight appressed or curly, erect hairs and short, multicellular capitate-glandular hairs (epidermis invisible even under high magnification), very often distinctly discoloured with the upper surface darker in colour and weakly scabrate. ♂ Inflorescence up to 2¹/₂ cm. Fruit ± globular. 2. *T. orientalis*
 3. Leaves beneath (fig. 16) densely or sparsely (but not completely) set with velvety greyish-brown erect hairs only (epidermis clearly visible between the hairs even under low magnification), mostly concolorous, dark-brown to blackish in dried specimens; upper surface strongly scabrate. ♂ Inflorescence up to 5 cm. Fruits ovoid, compressed 3. *T. tomentosa*
 1. Petiole (2–)3–6 (–8) mm. Leaves narrow ovate-lanceolate, (4–)5–6(–11) by (1¹/₄–)2–3(–4) cm, beneath densely tomentose by short, matted, rufous, 1-celled and multicellular glandular hairs (hoary). Inflorescence ♂ or ♂♀, at anthesis condensed and shorter or as long as petiole, 5–15-flowered. Mature fruit subglobose, 2–3 by 2 mm. 4. *T. angustifolia*
1. *Trema cannabina* LOUR. Fl. Coch. 2 (1790) 563; MERR. Trans. Am. Phil. Soc. 24, 2 (1935) 131; DE WIT, Bull. Bot. Gard. Btzg III, 18 (1949) 184; BACK. & BAKH. f. Fl. Java 2 (1965) 12; SOEPADMO in Whitmore, Tree Fl. Mal. 2 (1973) 421. — *Celtis amboinensis* WILLD. Sp. Pl. 4, 2 (1805) 997. — *Celtis commersonii* BRONGN. in Duperrey, Voy. Bot. Coq. Phan. (1829) 215. — *Sponia commersonii* (BRONGN.) DECNE, Nouv. Ann. Mus. Hist. Nat. III, 3 (1834) 498; PLANCH. Ann. Sc. Nat. III, 10 (1848) 317; in DC. Prod. 17 (1873) 198. — *Sponia timorensis* DECNE, Nouv. Ann. Mus. Hist. Nat. III, 3 (1834) 498; PLANCH. Ann. Sc. Nat. III, 10 (1848) 318; in DC. Prod. 17 (1873) 196; MIQ. Fl. Ind. Bat. 1, 2 (1859) 216. — *Sponia amboinensis* (WILLD.) DECNE, Nouv. Ann. Mus. Hist. Nat. III, 3 (1834) 498, *quoad nomen*. — *Sponia virgata* PLANCH. Ann. Sc. Nat. III, 10 (1848) 316; in DC. Prod. 17 (1873) 195, *incl. var. major* PLANCH. l.c. 196; MIQ. Fl. Ind. Bat. 1, 2 (1859) 216; KURZ, For. Fl. Burma 2 (1877) 469. — *Sponia glabrescens* PLANCH. Ann. Sc. Nat. III, 10 (1848) 317; MIQ. Fl. Ind. Bat. 1, 2 (1859) 217. — *Sponia viridis* PLANCH. Ann. Sc. Nat. III, 10 (1848) 319. — *T. commersonii* (BRONGN.) BL. Mus. Bot. 2 (1856) 60. — *T. timorensis* (DECNE) BL. l.c. 60; HOOK. f. Fl. Br. Ind. 5 (1888) 483; HEMS. J. Linn. Soc. Bot. 26 (1894) 452; LAUT. Bot. Jahrb. 50 (1913) 317, *incl. var. carinata* (BL.) LAUT. et var. *pallida* (BL.) LAUT.; HAND.-MAZZ. Symb. Sin. 7 (1929) 107. — *T. virgata* (PLANCH.) BL. Mus. Bot. 2 (1856) 59; J. J. SMITH in K. & V. Bijdr. 12 (1910) 652; LAUT. Bot. Jahrb. 50 (1913) 313, *incl. var. pubigera* (BL.) LAUT. l.c. 315; SCHNEIDER in Sargent, Pl. Wils. 3 (1917) 289; RIDL. Fl. Mal. Pen. 3 (1924) 319; GAGNEP. Fl. Gén. I.-C. 5 (1927) 686; HAND.-MAZZ. Symb. Sin. 7 (1929) 106; CORNER, Ways. Trees (1940) 694; LI, Woody Fl. Taiwan (1963) 109. — *T. amboinensis* (WILLD.) BL. Mus. Bot. 2 (1856) 61, *quoad nomen, excl. syn. et sched.*; MERR. Int. Rumph. (1917) 187. — *T. viridis* (PLANCH.) BL. Mus. Bot. 2 (1856) 58. — *T. glabrescens* (PLANCH.) BL. l.c. 58. — *T. carinata* BL. l.c. 59. — *T. pallida* BL. l.c. 60. — *T. pubigera* BL. l.c. 60. — *T. morifolia* BL. l.c. 59; LAUT. Bot. Jahrb. 50 (1913) 318. — *Sponia pallida* (BL.) MIQ. Fl. Ind. Bat. 1, 2 (1859) 215; PLANCH. in DC. Prod. 17 (1873) 196. — *Sponia carinata* (BL.) MIQ. Fl. Ind. Bat. 1, 2 (1859) 215; PLANCH. in DC. Prod. 17 (1873) 202. — *Sponia pubigera* (BL.) MIQ. Fl. Ind. Bat. 1, 2 (1859) 216; PLANCH. in DC. Prod. 17 (1873) 197. — *Sponia morifolia* (BL.) PLANCH. in DC. Prod. 17 (1873) 196. — *Sponia vieillardii* PLANCH. l.c. 201. — *Sponia aspera* var. *viridis* (PLANCH.) BTH. Fl. Austr. 6 (1873) 158. — *T. orientalis* var. *amboinensis* (WILLD.) KURZ, For. Fl. Burma 2 (1877) 469, *quoad nomen*. — *T. vieil-*

lardii (PLANCH.) SCHLTR, Bot. Jahrb. 36 (1905) 31.

Shrub or small much-branched tree up to 6 m, 15 cm Ø. Bark smooth, grey-brown. Branchlets slender, spreading, often drooping, initially densely silvery-hairy, glabrescent and sparsely lenticellate. Stipules linear-lanceolate, 5–7 by 1–2 mm. Leaves chartaceous to thin-coriaceous, narrow ovate-caudate to broad ovate-acute, or elliptic-lanceolate, (3–)5–10(–13) by (1½–)2–4(–5½) cm (index 2–3 (–4)), broadest below or at the middle; base rounded to attenuate and acute, rarely subcordate, slightly contracted and more or less symmetrical; margin serrulate to denticulate for its entire length; apex with a sharp tip; above glabrous and variously scabrate, beneath glabrous or sparsely appressed-hairy; midrib and nerves raised beneath, impressed above; nerves (2–)3–4(–5) pairs, arcuate and sub-parallel, basal ones running up to ± 2/3 the length of the leaf; reticulations fine, subscalariform, obscure to visible beneath; petiole (5–)8–12(–15) by 1–2 mm, glabrescent. Inflorescence ♂ or ♀, with slender axes, 10–15-flowered, at anthesis lax, c. 1–2½ cm long, densely greyish appressed-hairy; bracts ovate-acute, c. 2–3 by 1 mm. — ♂ Flowers c. 1–2 mm Ø, outside sparsely hairy, glabrescent; perianth lobes 4–5, membranous, oblong-lanceolate, c. 1–1½ by ½–1 mm; filaments c. 1 mm, anthers c. 1 by ½ mm; pistillode obovoid, compressed, c. 1 by ½ mm. — ♀ Flowers c. 1½–2 by 1–1½ mm; perianth lobes mostly 5, membranous, glabrous, ovate-acute, c. 1–1½ by ½ mm; staminode absent; ovary c. 1 by ½ mm; stigmatic arms spreading or incurved. Drupe 2–3 by 2 mm, turning deep-orange or red when ripe. Endosperm copious.

Distr. Burma, China, Formosa, Hainan, Indo-China, Thailand, common throughout Malesia to Australia, Melanesia (Solomons, New Caledonia, New Hebrides), W. Polynesia (Fiji, Samoa), and Micronesia.

Ecol. Common as a pioneer in newly opened up habitats along roadsides, edges of forests, regrowths, thickets, and in young secondary vegetation, from sea-level up to 1200 m. Fl. fr. Jan.–Dec. At least in Malaya pollination is affected by wind and by small insects (diptera). Ripe fruits are dispersed by various species of bulbuls.

Taxon. In Malesia there seem to be three rather but not completely distinct entities. These can be defined as follows: (i) specimens which have a completely glabrous, chartaceous and narrow-ovate leaf of (3–)5–8(–10) by (1½–)2–3(–4) cm with an index of 2½–3, more or less non-scabrate upper surface, and 2–3 lateral nerves (*T. cannabina* and *T. virgata*); (ii) specimens with a thin-coriaceous, narrow ovate-lanceolate to elliptic-lanceolate leaf of (6–)7–10(–12) by (1½–)2–3(–3½) cm, with an index of 4–5, slightly scabrate upper surface and sparsely hairy lower surface, and 4–5 lateral nerves which are straight and ascending and forming a narrow angle (less than 40°) with the midrib (*T. timorensis*, *T. virgata* var. *scabra*, and *T. cannabina* var. *scabra*); (iii) those with a broad ovate and coriaceous leaf of (8–)9–11(–13) by (3–)4–4½(–5½) cm, with an index of 2½–3, rugose and slightly scabrate upper surface and sparsely pubescent beneath, and 3–4 lateral nerves forming a broad angle (more than 45°) with the midrib (*T. glabrescens*, *T. viridis*, and *T. vieillardii*). Various intermediates are how-

ever present, making it difficult to recognize them as distinct infra-specific taxa.

Vern. Malaya: *ménèrong*, *mèngkirai*, M; S. Sumatra: *dèlung*, M, Palembang; Java: *anggrung*, J; N. Borneo: *bintanong*, Murud; Lesser Sunda Is.: *rèdong kué*, Flores, *pépaka*, Alor; Moluccas: *loli-sawu*, Halmahera; Solomons: *bulassisi*, Kwara.

2. *Trema orientalis* (L.) BL. Mus. Bot. 2 (1856) 62; BTH. Fl. Austr. 6 (1873) 158; HOOK. f. Fl. Br. Ind. 5 (1888) 484; J. J. SMITH in K. & V. Bijdr. 12 (1910) 655, p.p., excl. syn. *T. commersonii* et *T. griffithii*; LAUT. Bot. Jahrb. 50 (1913) 320, p.p., incl. var. *rigida* (BL.) LAUT. l.c. 322, excl. var. *viridis* et var. *amboinensis*; CORNER, Ways. Trees (1940) 694, pl. 211, p.p. excl. syn.; DE WIT, Bull. Bot. Gard. Batz III, 18 (1949) 189, p.p., incl. var. *bicornis* DE WIT, l.c. 190, excl. var. *bicolor* et syn. *T. angustifolia*, *T. imbricata* et *T. velutina*; BACK. & BAKH. f. Fl. Java 2 (1965) 12, p.p., excl. syn. *T. amboinensis* auct. non (WILLD.) BL.; SOEPADMO in Whitmore, Tree Fl. Mal. 2 (1973) 421. — *Celtis orientalis* LINNÉ, Sp. Pl. 2 (1753) 1044; ROXB. Fl. Ind. ed. Carey 2 (1832) 65. — *Celtis rigida* BL. Bijdr. (1825) 486. — *Celtis discolor* BRONGN. in Duperrey, Bot. Voy. Coq. Phan. (1829) 215, pl. 47B. — *Sponia discolor* (BRONGN.) DECNE, Nouv. Ann. Mus. Hist. Nat. III, 3 (1834) 498; PLANCH. Ann. Sc. Nat. III, 10 (1848) 324; in DC. Prod. 17 (1873) 201. — *Sponia orientalis* (L.) DECNE, Nouv. Ann. Mus. Hist. Nat. III, 3 (1834) 498; PLANCH. Ann. Sc. Nat. III, 10 (1848) 323; in DC. Prod. 17 (1873) 200. — *Sponia rigida* (BL.) DECNE, Nouv. Ann. Mus. Hist. Nat. III, 3 (1834) 498; PLANCH. Ann. Sc. Nat. III, 10 (1848) 336; MIQ. Fl. Ind. Bat. 1, 2 (1859) 217. — *Sponia argentea* PLANCH. Ann. Sc. Nat. III, 10 (1848) 323; in DC. Prod. 17 (1873) 201. — *Sponia wightii* PLANCH. Ann. Sc. Nat. III, 10 (1848) 322; WIGHT, Ic. 6 (1853) t. 1971. — *T. argentea* (PLANCH.) BL. Mus. Bot. 2 (1865) 58. — *T. burmannii* BL. l.c. 62. — *T. rigida* (BL.) BL. l.c. 61. — *T. scaberrima* BL. l.c. 63. — *T. wightii* (PLANCH.) BL. l.c. 58. — *T. discolor* (BRONGN.) BL. l.c. 58; LAUT. Bot. Jahrb. 50 (1913) 319. — *Sponia scaberrima* (BL.) MIQ. Fl. Ind. Bat. 1, 2 (1859) 217; PLANCH. in DC. Prod. 17 (1873) 202. — *Sponia burmannii* (BL.) PLANCH. in DC. 17 (1873) 200. — Fig. 13, 16.

Shrub to large tree, 3–36 m, 10–90 cm Ø. Buttresses, if present, up to 1¼ m. Bark smooth to finely fissured, lenticellate, grey-brown or whitish-grey. Branchlets, stipules, petioles, and inflorescences densely set with appressed and matted or erect silvery to glaucous 1-celled hairs and short multicellular glandular hairs. Stipules linear-lanceolate to ovate-acute, 3–4 by 1–2 mm. Leaves thin- to thick-coriaceous, often rigid and brittle, ovate, ovate-lanceolate to narrow elliptic, lanceolate, (6–)10–15(–18) by (1½–)2½–6(–10) cm, index (2–)3–4(–5½), broadest at or mostly below the middle, mostly discolorous, above dull grey-brown or grey-green in dried specimens, scabrate and sparsely set with bulbous-based hairs, beneath densely tomentose by a combination of silvery, glaucous or grey-brown, appressed 1-celled hairs and shorter multicellular glandular hairs (fig. 16); base cordate, rounded, or sometimes truncate, often contracted, asymmetrical or symmetrical; margin serrate to denticulate for its entire length;

apex acute to acuminate-caudate; midrib and nerves raised beneath and impressed above; nerves 4–6(–8) pairs, the lowest pair arcuating and running up to $\frac{1}{2}$ – $\frac{2}{3}$ the length of the leaf; reticulations subscalariform to subareolate, sometimes strongly raised and distinct beneath; petiole (7–)10–15(–18) by 1–2 mm, densely short pubescent. *Inflorescences* either ♂ or ♀ borne on separate vegetative branches, a much-branched panicle or thyrse, at anthesis lax or condensed, axes 1–2 mm thick; bracts ovate-acute, 2–3 by 1 mm. Flowers 5-merous. — ♂ *Inflorescences* up to 3–5 cm long, 20–100-flowered; ♂ flower c. $1\frac{1}{2}$ –2 mm Ø; perianth lobes ciliate, $1\frac{1}{2}$ –2 by 1 mm; filaments 1– $1\frac{1}{2}$ mm, anthers c. 1 by $\frac{1}{2}$ mm, pistillode obovoid-conical, compressed, $1-1\frac{1}{2}$ by $\frac{1}{2}$ –1 mm. — ♀ *Inflorescences* 5–15-flowered, $1\frac{1}{2}$ – $2\frac{1}{2}$ cm long, axes 1–2 mm thick; ♀ flower c. 2–3 by 1–2 mm; perianth lobes ovate acute, c. $1-1\frac{1}{2}$ by $\frac{1}{2}$ mm, ciliate and densely short pubescent, glabrescent; staminate absent; ovary ovoid-conical, c. 2 by 1 mm; stigmatic arms slender, c. $1-1\frac{1}{2}$ mm., spreading. *Drupe* 3–5 by 2–4 mm, turning black when ripe. Endosperm scanty to copious.

Distr. ?Tropical Africa, SE. Asia (Ceylon, India: from W. Himalayas to Bombay and Malabar; Burma, Thailand, Indo-China, China, also Hainan, Formosa, to S. Japan), through Malesia to Queensland, Melanesia (Solomons), Micronesia (Marianas), and Polynesia (Fiji, Tonga, Tahiti). In *Malesia*: Malay Peninsula and Sumatra (rather rare), Java (rather common in the hills and sub-montane regions), Lesser Sunda Islands (rare), Borneo (common), Philippines (rather common), Celebes (rather rare), Moluccas (rare), and New Guinea (incl. New Britain, rare).

Ecol. In W. Malesia and continental Asia the species is more common in the hills and montane regions between 600–2000 m, whereas in E. Malesia, Australia, and Pacific Islands it is more common in the lowlands. The ripe fruits which turn to deep purple or black are dispersed by

various species of birds, particularly bulbuls. *Fl. fr.* Jan.–Dec.

Taxon. Three rather but not completely distinct entities may be recognized. These are: (i) specimens from continental Asia and W. Malesia which have been variously identified as *T. orientalis*, *rigida*, *argentea*, and *wightii* by previous authors. They are characterized by: thick-coriaceous, broadly ovate to ovate-elliptic leaves with grey-brown to glaucous indumentum, slightly asymmetrical to symmetrical cordate, subcordate or rounded base, rugose upper surface, and acute to acuminate apex; and by a relatively larger fruit of c. 4–5 by 3–4 mm and stouter inflorescence axes.

(ii) Specimens from S. Japan, Formosa, Hainan, the Philippines, New Guinea, Micronesia, Melanesia, and Polynesia, and Australia, which have been included in the so-called *T. discolor*, characterized by: thin-coriaceous, narrow-ovate leaves with strongly asymmetrical cordate base, hardly scabrate upper surface, short and matted silvery to grey-brown indumentum, lax inflorescence with slender axes, and fruits c. 3–4 by 2–3 mm.

(iii) A few specimens from scattered localities in S. China, Thailand, Sumatra, and Borneo, which have been described by DE WIT (1949) as *T. orientalis* ssp. *bicornis*, characterized by: very narrow, ovate-lanceolate thin-coriaceous leaves with silvery appressed and matted dense indumentum on the lower surface and non-scabrate upper surface, 6–8 pairs of nerves, and the shorter and few-flowered inflorescence.

Several intermediates are present however, making formal infraspecific distinction not advisable.

Vern. Sumatra: *endrung*, *ndörung*, Karo, *indarung*, Pajakumbu, *bandorung*, Tapanuli, *landojung*, Simelungun, *ëndelung*, Palembang, Bencoolen, *magëlong*, *nëlung*, Bencoolen, *nëriung*, Lampung. Java: *gorai*, *kuraj*, S. *anggrung*, *njampu*, J. Lesser Sunda Is.: *lënggung*, Bali, *rëdong*, Flores, *tabelah*, W. Sumbawa. Borneo: *randagong*,



Fig. 16. Indument of lower leaf-surface, strongly enlarged. Left: only unicellular hairs of *Trema tomentosa* (ROXB.) HARA, between which the epidermis is visible. Right: *T. orientalis* (L.) BL., with long unicellular hairs and crowded multicellular crisped hairs covering the epidermis.

tandago, Dusun; *bēngkirai*, E. Kutai. Philippines: *anadgong*, Bis. Celebes: *ngawoi*, Malili, *mawa*, Bonthain, *kantu*, Toradja, *tajapu*. Moluccas: *rufu*, Ternate, *laei*, Tidore, *soka soka*, E. Ceram. West New Guinea: *bēsuwai*, Hattam lang., *karara*, Ambai, *kaniem*, *mier*, Kebar lang.

3. *Trema tomentosa* (ROXB.) HARA, Fl. E. Himal. 2 (1971) 19; SOEPADMO in Whitmore, Tree Fl. Mal. 2 (1973) 423. — *Celtis orientalis* (non L.) BL. Bijdr. (1825) 485. — *Celtis amboinensis* (non WILLD.) BRONGN. in Duperrey, Bot. Voy. Coq. Phan. (1829) 212, pl. 47A, p.p., excl. *specim. ex Ventenat*, *Amboina*. — *Celtis tomentosa* ROXB. Fl. Ind. ed. Carey 2 (1832) 66. — *Sponia amboinensis* (WILLD.) DECNE, Nouv. Ann. Mus. Hist. Nat. III, 3 (1834) 498, *quoad specim.*; PLANCH. Ann. Sc. Nat. III, 10 (1848) 321; MIQ. Fl. Ind. Bat. 1, 2 (1859) 216; PLANCH. in DC. Prod. 17 (1873) 198. — *Celtis lima* (non Sw.) BLANCO, Fl. Filip. 2 (1837) 139. — *Sponia griffithii* PLANCH. Ann. Sc. Nat. III, 10 (1848) 324. — *Sponia tomentosa* (ROXB.) PLANCH. l.c. 336. — *Sponia velutina* PLANCH. l.c. 327, p.p., excl. *specim. Cuming 1232 ex Luzon*. — *Sponia blancoi* PLANCH. l.c. 327; MIQ. Fl. Ind. Bat. 1, 2 (1859) 218. — *T. griffithii* (PLANCH.) BL. Mus. Bot. 2 (1856) 58. — *T. blancoi* (PLANCH.) BL. l.c. 58. — *T. imbricata* BL. l.c. 63. — *T. velutina* (PLANCH.) BL. l.c. 58; GAGNEP. Fl. Gén. I.-C. 5 (1927) 689; LI, Woody Fl. Taiwan (1963) 109. — *T. amboinensis* (WILLD.) BL. Mus. Bot. 2 (1856) 61, *quoad specim.*; BTH. Fl. Austr. 6 (1873) 159; HOOK. f. Fl. Br. Ind. 5 (1888) 484; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 264; J. J. SMITH in K. & V. Bijdr. 12 (1910) 659, p.p., excl. *syn. Celtis amboinensis* WILLD. et *Trema burmannii* BL.; MERR. En. Born. (1921) 217; RIDL. Fl. Mal. Pen. 3 (1924) 319. — *Sponia imbricata* (BL.) PLANCH. in DC. Prod. 17 (1873) 199. — *T. orientalis* var. *amboinensis* (WILLD.) KURZ, For. Fl. Burma 2 (1877) 469, *quoad specim.*; LAUT. Bot. Jahrb. 50 (1913) 321. — *T. orientalis* (non L.) BL. MERR. Sp. Blanc. (1918) 121. — *T. dielsiana* HAND.-MAZZ. Symb. Sin. 7 (1929) 106; P'EI, Bot. Bull. Ac. Sin. 1 (1947) 289. — Fig. 16.

Shrub to medium-sized tree of 5–15(–24) m, 5–30(–50) cm Ø. Bark grey-brown, smooth to finely fissured, lenticellate. Branchlets, inflorescences, petioles, stipules, and underside of leaves densely and thickly set with greyish, erect, velvety hairs. Stipules linear-lanceolate, c. 5 by 1 mm. Leaves thin- to thick-coriaceous, broadly ovate to ovate-elliptic, (5–)8–15(–19) by (2–)4–7(–9) cm, index 2½–3, broadest mostly below the middle; more or less concolorous, drying dark-chocolate brown to blackish brown; above strongly scabrate; base cordate, rarely subcordate or rounded, mostly strongly asymmetrical, rarely symmetrical; margin serrate throughout, apex acute to acuminate-caudate, acumen sharp, 1–3 cm; midrib and nerves raised beneath (often very strongly), impressed and hairy above; nerves 4–6 pairs, ascending and subparallel, at an angle of ± 45°, the lowest pair running to ± ½–⅓ the length of the leaf; reticulations subscalariform to subareolate, often rather distinct beneath; petiole 1–1½ cm by 1–2 mm, densely pubescent. Inflorescences ♂, ♀, or ♂♀, either on the same or on different vegetative branches; bracts ovate-acute, c. 1 by ½ mm. — At anthesis ♂ and ♂♀ axes of the inflorescences lax, 2½–4½ cm

long, 20–100-flowered; ♂ flower c. 1½–2 mm Ø; perianth lobes mostly 5, elliptic, c. 1½ by 1 mm; filaments c. 1 mm, flat, glabrous, anthers c. 1 by ½ mm; pistillode obovoid-ellipsoid, compressed, 1½ by ½ mm. — ♀ Inflorescence 1–2 cm long, axes 1–2 mm thick, 5–15-flowered; ♀ flower c. 2 by 1 mm; perianth lobes 4–5, ovate-acute, c. 1 by ½ mm; staminode mostly absent, if present strongly reduced in size and non-functional; ovary c. 1½ by ½–1 mm, stigmatic arms slender, c. 1 mm, spreading. Drupe c. 3 by 2 mm, maturing black. Endosperm copious.

Distr. East tropical Africa, Madagascar, SE. Asia: Pakistan, India, Bangladesh, Burma, Thailand, Indo-China, China (incl. Hainan), Hong-kong, Formosa, Ryu Kyu Is. (Okinawa), throughout *Malesia* to Queensland, Melanesia (New Caledonia), Micronesia, and Polynesia (Fiji, Tonga, and Hawaii).

Ecol. Common in the lowlands and hills, at sea-level up to 1000 m, as a pioneer plant invading and occupying newly opened up habitats on all kind of soils, including limestones. Fl. fr. Jan.–Dec. At least in Malaya pollination is affected by wind and small insects (diptera). The ripe black fruit is dispersed by various species of birds.

Taxon. Evidently, *T. tomentosa* is closely allied to *T. orientalis*, and it is possible that, when more field data become available in the future, the former may prove to be only representing a juvenile ontogenetical form of the latter. Except for a few specimens from the Philippines (e.g. WHITFORD 681, BS 37313, 48355, ELMER 8417) and from New Guinea (e.g. ANU 2075, 2752, 6240, HARTLEY 10937, MANNER & STREET 270, NGF 29353, SCHODDE 1419, and BW 16510) in which the leaves are thick-coriaceous and with a more or less symmetrical base and pale grey-brown in colour, specimens of *T. tomentosa* can be easily distinguished from those of *T. orientalis* by the characters mentioned in the key. Fig. 16. It is also interesting to note that according to HANS (Cytologia 36, 1971, 341) and MEHRA (Nucleus 15, 1972, 64) the chromosome number in *T. tomentosa* is $n = 10$ or 80, whereas that of *T. orientalis* is $n = 10, 18$, or 20.

Vern. Malay Peninsula: *mēnaron*, *mēndarong*, *mēngkirai*, M. Sumatra: *bēngkirai*, Gajo, *ēndēlung*, Palembang, *eēmaha*, Enggano, *hana(w)e*, Batak, *kamēsēn silai*, Simalur, *mangkirai*, Pajakumbu, *manghirei*, *mēnkirei*, Lingga, *mudēn sabu*, Djambi, (n)dēr(r)ung, Karo-Batak, *rundurung*, Toba, *sangkiraja*, Batak, *tindjau*, Riouw, Java: *anggrung*, J, *kuraj*, k. *awēwēna*, S. Lesser Sunda Is.: *rēdong*, *damot*, Flores, *ruka parak*, Sumba. Borneo: Sarawak: *murieng*, Bidjauh, *kērenēnog*, Iban, *tuku baroh*, Land Dayak; N. Borneo: *anjalakat*, Kedayan; Brunei: *balēk balēk angin jantan*, *balik angin*, *rundagong*, Brunei, *bintanong*, Murut, *damai*, Suluk, *entimon*, Iban, *lindagong*, Kedayan, *landagong*, Dusun Tambato & Kayan, *lundagong*, *sali-muak*, Dusun, *rundagong*, Tenggara, *rēndagong*, Dusun Labuk; E. Borneo: *bangērai*, *bangkirai*, *tjalundung*, E. Kutai; W. Borneo: *ēngkirai*, *butu*. Philippines: *anaginong*, Mang., *anugdon*, Tag-Bis., *anabiong*, *hanagdong*, Tag., *karangyan*, *karayangyang*, Tagb. Moluccas: *mandalirung'a*, Talaud, *pohon rupong*, Banda, *rufut*, Buru. West New Guinea: *fidukwa*, Manokwari, *hormas*, Sorong; East New Guinea: *komukai*, Maring name, *natua*,



Fig. 17. Young blukar (regrowth or secondary forest) on an abandoned tea estate near Tapos, West Java, c. 1000 m, consisting of three layers: 2 m high stand of *Eupatorium inulifolium*, 5–6 m high tree ferns of *Cyathea contaminans*, above which is an open canopy of *Trema orientalis* (L.) BL. (Photogr. VAN STEENIS).

Kainantu, *seraun*, Daga-Bonenau, *wanip*, Enga lang., *wantip*, Medlpa, Wahgi, *wan'um*, Mendi.

4. *Trema angustifolia* (PLANCH.) BL. Mus. Bot. 2 (1856) 58; HOOK. f. Fl. Br. Ind. 5 (1888) 484; GAGNEP. Fl. Gén. I.-C. 5 (1927) 686; HAND.-MAZZ. Symb. Sin. 7 (1929) 108. — *Sponia angustifolia* PLANCH. Ann. Sc. Nat. III, 10 (1848) 326; MIQ. Fl. Ind. Bat. 1, 2 (1859) 215; PLANCH. in DC. Prod. 17 (1873) 202. — *Sponia acuminatissima* MIQ. Sumatra (1861) 410; PLANCH. in DC. Prod. 17 (1873) 202. — *Sponia sampsonii* HANCE, Ann. Sc. Nat. V, 5 (1866) 242. — *T. acuminatissima* (MIQ.) BOERL. Handl. 3 (1900) 358. — *T. lanceolata* MERR. Lingn. Sc. J. 7 (1931) 302. — *T. sampsonii* (HANCE) MERR. & CHUN, Sunyatsenia 5 (1940) 40. — *T. orientalis* var. *bicolor* DE WIT, Bull. Bot. Gard. Btzg III, 18 (1949) 190.

Shrub or small tree with spreading and drooping branches, 3–7 m, 5–15 cm Ø. Branchlets densely set with rufous multicellular glandular hairs and glaucous short and matted 1-celled hairs, sub-glabrescent. Stipules linear-lanceolate, 3–4 by 1 mm. Leaves chartaceous to thin-coriaceous, narrow ovate-lanceolate to lanceolate, (3–)5–8(–10) by (1–)2–3(–4) cm, index 3–3½, broadest below or at the middle; discolorous, upper surface strongly scabrate, dark chocolate-brown to blackish-brown,

lower surface densely set with short and matted rufous to glaucous 1-celled and multicellular glandular hairs; base rounded to attenuate, symmetrical; margin finely serrate throughout; apex acute to acuminate; midrib and nerves slightly raised beneath, impressed above; nerves 4–5 pairs, straight, ascending at 30–40°; reticulations fine, subscalariform to subareolate, obscure above and faintly visible beneath; petiole (2–)3–6(–8) by 1 mm, densely short hairy. Inflorescences ♂ or ♀, densely set with a short rufous indumentum, much-branched, (5–)10–15(–30)-flowered, at anthesis condensed, shorter than or as long as the petiole; bracts narrow ovate-acute, c. ½–1 by ¼–½ mm. — ♂ Flowers c. 1–1½ mm Ø; perianth lobes 5, elliptic, c. 1–1½ by 1 mm; filaments c. 1 mm long, c. ½–1 mm Ø; pistillode obovoid-ellipsoid, strongly compressed, c. ½–1 by ¼ mm. — ♀ Flowers ovoid-conical, c. 2 by 1 mm; perianth lobes 5, narrow-lanceolate, acute, ½–1 by ¼–½ mm; staminode absent; ovary c. 1–2 by 1 mm; stigmatic arms c. ½–1 mm, spreading or incurved. Drupe c. 1½–2 mm Ø, turning orange to red when ripe. Endosperm copious.

Distr. China (Yunnan, Hainan), Thailand, and Indo-China; in Malesia: Malay Peninsula (common), Sumatra (rare), Borneo (rare), Celebes (very rare).

Ecol. Scattered in newly available habitats in the lowlands to submontane regions, from sea-level to 1200 m. *Fl. fr.* Jan.–Dec. Ripe fruits are dispersed by various species of bulbuls.

Vern. Malaya: *mēnarong*, *mēngkirai*, M; Sumatra: *kayu angguring*, M, Eastcoast, *mangkirai kējil*, M, Palembang.

Excluded

Trema (Parasponia) lancifolia RIDL. J. Mal. Br. R. As. Soc. 1 (1923) 91 = *Debregeasia longifolia* (BURM. f.) WEDD. (*Urticaceae*).

4. CELTIS

LINNÉ, *Gen. Pl.* ed. 5 (1754) 467; *Sp. Pl.* 2 (1753) 1043; PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 262; BL. *Mus. Bot.* 2 (1856) 70; MIQ. *Fl. Ind. Bat.* 1, 2 (1859) 220; PLANCH. in DC. *Prod.* 17 (1873) 168; B. & H. *Gen. Pl.* 3 (1880) 354; ENGL. in E. & P. *Nat. Pfl. Fam.* 3, 1 (1888) 63; BERNARD, *Bull. Herb. Boiss.* II, 5 (1905) 1112, maps 9–15; J. J. SMITH in K. & V. *Bijdr.* 12 (1910) 639; LEROY, *Fl. Madag. et Com. Fam.* 54 (1952) 3; POLHILL, *Kew Bull.* 19 (1964) 139; HUTCH. *Gen. Fl. Pl.* 2 (1967) 147; ELIAS, *J. Arn. Arb.* 51 (1970) 32; SOEPADMO in Whitmore, *Tree Fl. Mal.* 2 (1973) 414. — *Solenostigma* ENDL. *Prod. Fl. Norf.* (1833) 41; BL. *Mus. Bot.* 2 (1856) 66; MIQ. *Fl. Ind. Bat.* 1, 2 (1859) 219. — **Fig. 18, 20, 22–23.**

Small to large monoecious or polygamo-monoecious trees, often buttressed. Bark smooth or finely fissured, often conspicuously warty lenticellate. Branches (in Mal.) unarmed, initially densely yellow-brown or rufous-hairy, glabrescent; hairs 1-celled. Buds enclosed by the overlapping stipules or naked. Stipules thick and tough, peltately attached or free and scarious, caducous. *Leaves* entire or not, 3-nerved at base, semideciduous or persistent. *Inflorescences* ♂, ♀, or ♂♀, branched racemes or panicles, few- to many-flowered, axillary or subterminal on the new shoot; staminate inflorescences borne on the lower and leafless part or in the axil of leaves of the new shoot; in the ♂♀ inflorescence the ♀ flowers are borne on the distal ends of the axes; bracts minute, caducous. — *Staminate* (♂) *flowers* globular, pedicelled or sessile; perianth lobes 4–5, imbricate in bud, membranous, boat-shaped, outside sparsely pubescent, at anthesis recurved, caducous; stamens glabrous, inserted on the densely pilose receptacle; filaments subulate, incurved in bud and spreading elastically, exerted at anthesis; anthers ovoid to subreniform, dorsifixed just above the emarginate base, extrorse; pistillode present or absent. — ♀ *Flowers* ovoid, pedicelled; perianth lobes 4–5, imbricate in bud, connate at base, membranous, outside sparsely pubescent, boat-shaped, at anthesis recurved, caducous; stamens well-developed and functional or rudimentary, other characters as in ♂ flowers; ovary ovoid-ellipsoid, sessile, style short or ± absent; stigmatic arms elongate, divergent, the tips entire to deeply bifid; ovule anatropous. *Drupe* fleshy, ovoid, ellipsoid or globose; exocarp thick and firm, mesocarp thin and fleshy, containing slimy substances; endocarp hard and persistent, smooth or variously ridged or pitted. *Seed*: coat membranous, chalazal area broad, dark-coloured and close to the minute hilum; endosperm scanty or wanting, oily or gelatinous, nearly enclosed between the folds of the cotyledons. Embryo curved, cotyledons broad, foliaceous, equal or unequal in thickness, flat or conduplicate, variously folded, incumbent on or embracing the short superior and ascending radicle. Germination epigeal.

Distr. About 50–60 *spp.*, widely distributed in tropical and temperate regions of the world, the majority of species (30–40) in the Old and New World tropics, throughout *Malesia* (9 *spp.*). **Fig. 19, 21.**

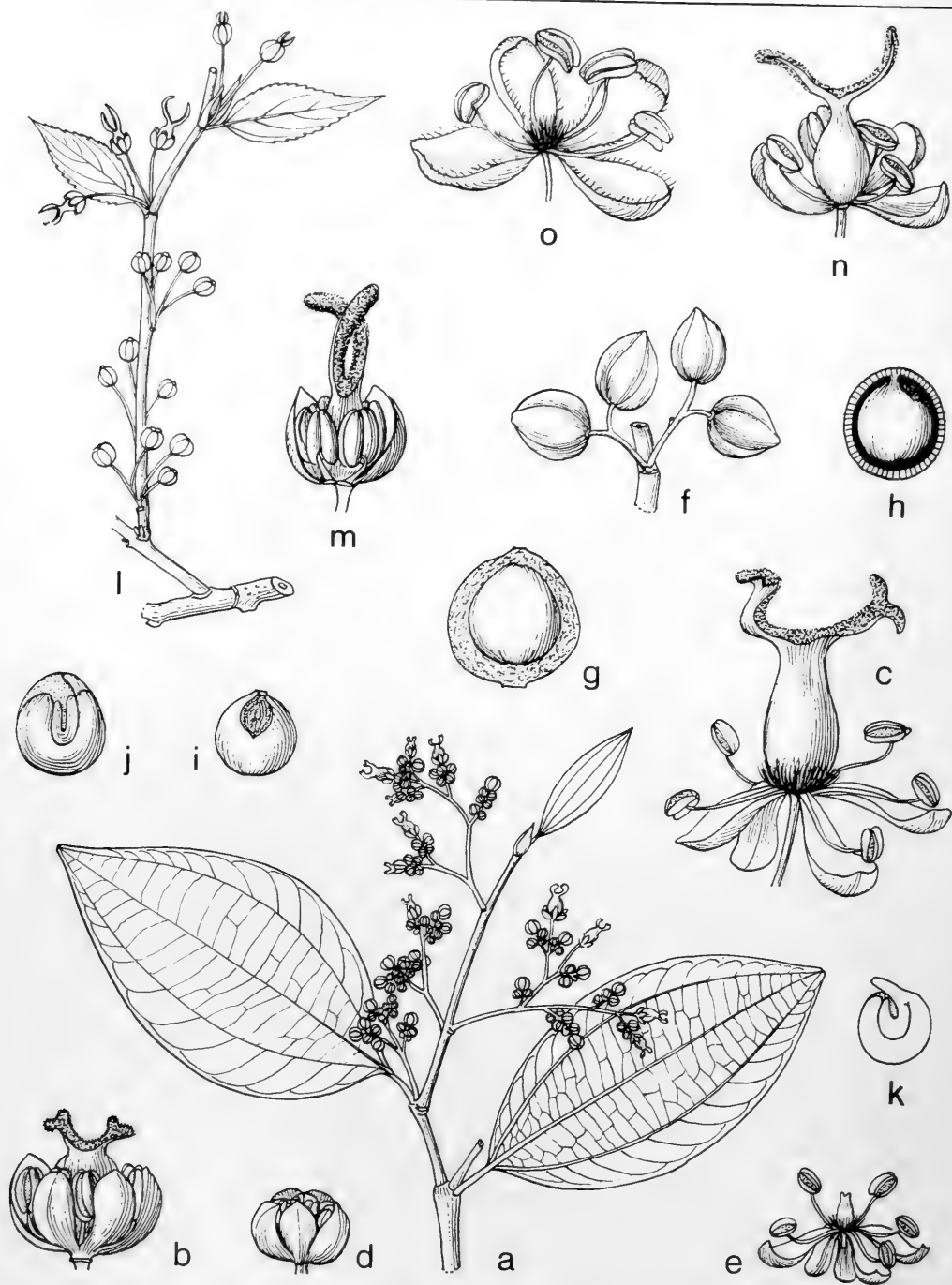


Fig. 18. *Celtis philippensis* BLANCO. a. New shoot bearing flowers, $\times \frac{2}{3}$, b-c. ♀ flowers, $\times 8$, d-e. ♂ flowers, $\times 10$, f. fruits, $\times \frac{2}{3}$, g. fruit, exocarp in LS, $\times 1\frac{1}{3}$, h. stone, endocarp in LS, $\times 1\frac{1}{3}$, i. seed showing testa and chalaza, nat. size, j. ditto in LS showing folded cotyledons, shaded oily endosperm, $\times 1\frac{1}{3}$, k. embryo in LS, $\times 1\frac{1}{3}$. — *C. tetrandra* ROXB. l. New shoot bearing flowers, $\times \frac{2}{3}$, m-n. ♀ flowers, $\times 8$, o. ♂ flowers, $\times 10$ (a-c MERRILL 52, d-e BS 1920, f-k BARTLETT 15071, l-o SCHMUTZ 1666).

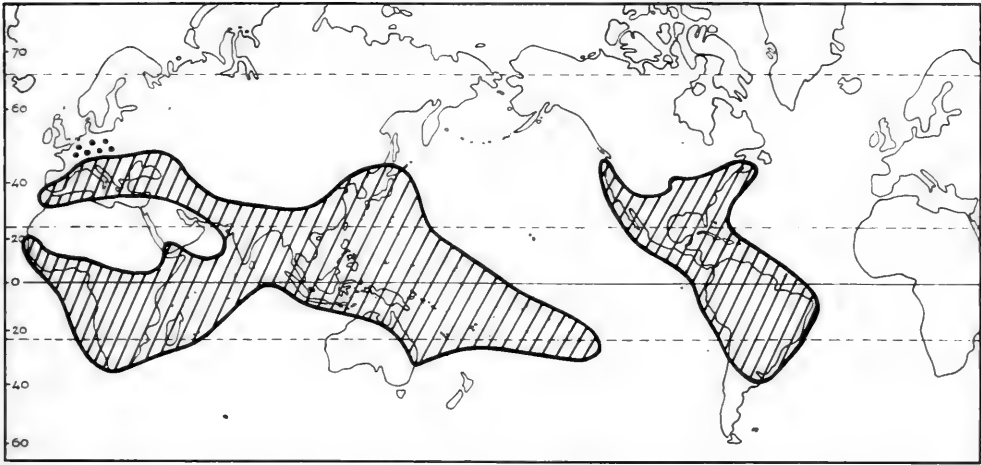


Fig. 19. Approximate range of *Celtis* L. Fossil records are indicated by dots.

Fossils. Numerous fossilized wood-fragments, leaf-impressions, drupes and pollen grains have been discovered in various localities in Europe, the U.S.A., and in Asia. According to ELIAS *l.c.* the first (oldest) records are apparently from the early Eocene in Wyoming and the late Eocene in Georgia, U.S.A. Continuing through the Oligocene, *Celtis* spp. are best known from the Miocene, fossilized material of younger age is relatively sparse at least in the U.S.A. — References: A. GRAHAM (ed.), *Floristics and Paleofloristics of Asia & Eastern North America* (1972) 147; GREGUSS, *Tert. Angios. Hung., Ak. Kiado Budapest* (1969) 83; LA MOTTE, *Mem. Geol. Soc. Am.* 51 (1952) 112. Fig. 19.

Ecol. Malesian species of *Celtis* may be classified into two rather distinct ecological groups, *i.e.* the *C. philippensis* var. *philippensis* and *C. tetrandra* groups. The first group, which includes also *C. hildebrandii*, *C. latifolia*, *C. luzonica*, *C. paniculata*, and *C. rigescens*, is found mainly in the lowland forests, both primary and secondary, and is an important constituent of the understorey tree community in moist areas. The *C. tetrandra* group, which includes *C. rubrovenia*, *C. timorensis*, and *C. philippensis* var. *wightii*, is confined to areas which are subject to a rather pronounced seasonal climate, or if they occur in wetter regions, they grow on strongly drained substrates, *e.g.* rocky shores, limestone, *etc.* In tune with this environmental preference, the second group shows a more prominent flush-wise growth habit and its species are completely or partly deciduous. In Malaya, species of *Celtis* are producing flowers around July–September, while fruit ripens January–March.

How pollination is affected is not certain, but judging from the structure and position of the inflorescence, some species (*e.g.* *C. philippensis* var. *philippensis*, *C. hildebrandii*, and *C. latifolia*) may be pollinated by insects, while others (*C. tetrandra*, *C. timorensis*, *C. rubrovenia*, and *C. rigescens*) may be pollinated by wind.

The ripe fleshy drupes which turn to orange, red or bluish-black may be dispersed by birds, or alternatively they may be dispersed by water as the embryo is protected by the hard, persistent and durable endocarp.

Morph. Except for *C. paniculata* the stamens of the pistillate flowers are well-developed and functional. In the male or staminate flowers the pistillode is rudimentary or completely absent in *C. tetrandra*, *C. timorensis*, and *C. rubrovenia*. In the other species the pistillode is present and relatively rather well-developed though non-functional.

Chromosomes. The chromosome numbers reported are: $n = 10$ ($2n = 20$) (*C. australis* var. *eriocarpa*, *C. inguana*, *C. laevigata*, *C. occidentalis*, *C. sinensis*, and *C. timorensis* (under *C. cinnamomea*)); $2n = 22$ (*C. spinosa*); $2n = 28$ (*C. occidentalis*); $2n = 40$ (*C. australis* and *C. tupalangi*). — References: SAX, *J. Arn. Arb.* 14 (1933) 82; BOWDEN, *Am. J. Bot.* 32 (1945) 195; DARLINGTON & WYLIE, *Chromos. Atlas* (1955) 182; MEHRA & GILL, *Taxon* 17 (1968) 574; GADELLA *et al.* *Acta Bot. Neerl.* 18 (1969) 74; MEHRA & HANS, *Taxon* 18 (1969) 310; FEDOROV (ed.), *Chromos. Numbers Flow. Pl.* (1969) 710; MEHRA & GILL, *J. Arn. Arb.* 55 (1974) 663.

According to SAX *l.c.* there seems to be at least in *C. occidentalis* a high degree of pollen sterility and a high incidence of meiotic irregularity. This may be one of the causes why in *Celtis* there is a very high percentage of barren seeds production, even among tropical species.

Embryology. No detailed study on the microsporogenesis, megasporogenesis and embryogenesis of *Celtis* species has ever been carried out. In Malesia the solitary ovule is bitegmic, anatropous and inserted just below the apex of the locule. After fertilization both integuments develop into thin membranous seed coats with a broad, dark-coloured, more or less circular chalaza. The endocarp becomes woody and very hard and impregnated by mineral deposits. It is persistent and becomes variously sculptured (ridged,

pitted, or nearly smooth). The embryo is strongly curved with the hypocotyle superior and ascending, situated in between or nearly enclosed by the broad, thick, foliaceous cotyledons. The cotyledonar lobes are somewhat unequal in thickness, and they are either induplicate or variously folded. Endosperm is very scanty to absent and either gelatinous or oily. Especially in *C. paniculata* and *C. tetrandra*, at least 70–80% of the fruits produced are barren. Though the fruits are developed normally, the embryo fails to grow and becomes shrivelled. As a result the fruits are empty.

KEY TO THE SPECIES

(Measurements of leaf and fruit based on fully mature material)

1. Leaves entire or nearly so. ♂ Inflorescence a much-branched many-flowered panicle with up to 150 flowers. Pistillode rather well-developed, c. $1-1\frac{1}{2}$ by $\frac{1}{2}-1$ mm. Stigmatic arms bilobed or bifid at the tip.
2. Leaves rugose, brittle, sparsely pubescent beneath; midrib and lateral nerves strongly raised beneath. Stipules not peltately attached, free from one another. Fruit densely appressed-hairy. 1. *C. rigescens*
2. Leaves not rugose, not brittle, glabrous; midrib and nerves only slightly raised beneath. Stipules peltately attached, overlapping. Fruit glabrous.
3. Leaves with (2–)3–5 pairs of nerves.
4. Leaves elliptic-orbicular or elliptic-oblong, index $(1\frac{1}{4}-)1\frac{1}{2}(-2)$; midrib and nerves slightly raised beneath; lowest pair of nerves running to $\frac{2}{3}-\frac{3}{4}$ the length of the leaf, upper pairs of nerves ascending and arcuating. Stigmatic arms shallowly bilobed at the tip. Fruit globose, 16–20 by 14–18 mm. 2. *C. luzonica*
4. Leaves elliptic or ovate-elliptic, index $(1\frac{1}{2}-)2-2\frac{1}{2}(-3)$; midrib and nerves flattish beneath; lowest pairs of nerves running up to $\frac{1}{3}-\frac{1}{2}(-\frac{2}{3})$ the length of the leaf; upper pairs of nerves weak, sub-horizontal. Stigmatic arms deeply bifid at the tip. Fruit ovoid or ellipsoid, 7–12 by 5–8 mm.
5. Nerves 3–5 pairs; lowest pair running to $\frac{1}{3}-\frac{1}{2}$ the length of the leaf. Inflorescence mostly ♂ or ♀. Stamens of ♀ flower rudimentary, non-functional. Fruit ovoid, feebly 4–5-angular in CS; endocarp with reticulate ridges. 3. *C. paniculata*
5. Nerves 1–2(–3) pairs; lowest pair running up to $\frac{2}{3}$ the length of the leaf. Inflorescence ♂ or ♂♀. Stamens of ♀ flower well-developed and functional. Fruit ellipsoid, ± terete; endocarp smooth. 4b. *C. philippensis* var. *wightii*
3. Leaves with 1 pair of nerves.
6. Leaf symmetrical. Inflorescence ♂ or ♂♀. ♂ Inflorescence 15–40-flowered. Cotyledons curved but not folded.
7. Leaves (4–)8–14(–18) by (2–)3–6(–8) cm; reticulations fine, dense. Ovary glabrous. Fruit 8–15 by 7–12 mm; endocarp smooth. 4a. *C. philippensis* var. *philippensis*
7. Leaves (8–)15–18(–25) by (6–)8–12(–18) cm; reticulations coarse, wide-spaced. Ovary densely appressed-pubescent. Fruit 15–25 by 10–18 mm; endocarp pitted. 5. *C. latifolia*
6. Leaf oblique. Inflorescence ♂ and ♀. ♂ Inflorescence 60–150-flowered. Cotyledons curved and many times folded. 6. *C. hildebrandtii*
1. Leaves serrulate to denticulate at least in the upper half. ♂ Inflorescence racemose, 5–20-flowered. Pistillode strongly reduced in size or absent. Stigmatic arms entire.
8. Leaf not strongly oblique in outline; nerves 1–2(–3) pairs. Inflorescence ♂ and ♂♀; ♂ flower 5-merous.
9. Leaves (6–)10–12(–17) by $(2\frac{1}{2}-)4-5(-8)$ cm, index $1\frac{1}{2}-2\frac{1}{2}$. ♂ Inflorescence 10–20-flowered. Ovary glabrous. Infructescence 4–5 cm long. Fruit ovoid, strongly beaked, 5–10 by 3–6 mm. 7. *C. timorensis*
9. Leaves (3–)4–5(–6 $\frac{1}{2}$) by $(1\frac{1}{4}-)1\frac{1}{2}-2\frac{1}{2}(-3\frac{1}{2})$ cm, index 2–3.3. ♂ Inflorescence 5–7-flowered. Ovary densely hairy. Infructescence c. $1\frac{1}{2}$ cm. long. Fruit globose, not beaked, c. 3 by 3 mm. 8. *C. rubrovenia*
8. Leaf strongly oblique; nerves 3–4 pairs. Inflorescence ♂ and ♀; ♂ flower 4-merous. 9. *C. tetrandra*

1. *Celtis rigescens* (MIQ.) PLANCH. in DC. Prod. 17 (1873) 182; SOEPADMO in Whitmore, Tree Fl. Mal. 2 (1973) 416. — *Solenostigma rigescens* MIQ. Sumatra (1861) 411. — *Solenostigma sumatrana* MIQ. l.c. 411. — *C. sumatrana* (MIQ.) PLANCH. in DC. Prod. 17 (1873) 181. — *C. nyanii* K.SCH. in K.Sch. & Laut. Fl. Schutzgeb. Nachtr. (1905) 240; LAUT. Bot. Jahrb. 50 (1913) 311. — *C. asperifolia* MERR. Philip. J. Sc. 17 (1920) 246; En. Philip. 2 (1923) 32. — Fig. 20e, 23a–b.

Large tree up to 45 m, 1 m Ø. Buttresses up to 6 m tall, 3 m out, 5 cm thick. Bark grey-brown, smooth, finely fissured to pustulate and lenticellate. Innovations densely yellowish brown to rufous simple hairy. Older twigs glabrous, finely striate

and sparsely minute lenticellate. Terminal buds ovoid-conical, c. 3 by 2 mm, scales densely yellowish-brown tomentose. Stipules linear-lanceolate, 4–5 by 1–1 $\frac{1}{2}$ mm. Mature leaves thick-coriaceous, strongly rugose, stiff and brittle when dry, ovate-elliptic to elliptic-oblong, (5–)8–12(–15) by $(2\frac{1}{2}-)3-5(-6\frac{1}{2})$ cm (index $1\frac{1}{2}-2\frac{1}{2}$), broadest at or slightly below the middle; above glabrous, shining, beneath sparsely yellowish-brown pubescent especially on midrib and nerves; base rounded to subcordate, symmetrical, rarely attenuate-rounded and slightly asymmetrical; margin undulate, entire or distantly serrate in the upper half, very often incurved; apex rounded-acute to acuminate; midrib and nerves strongly raised beneath, flattish

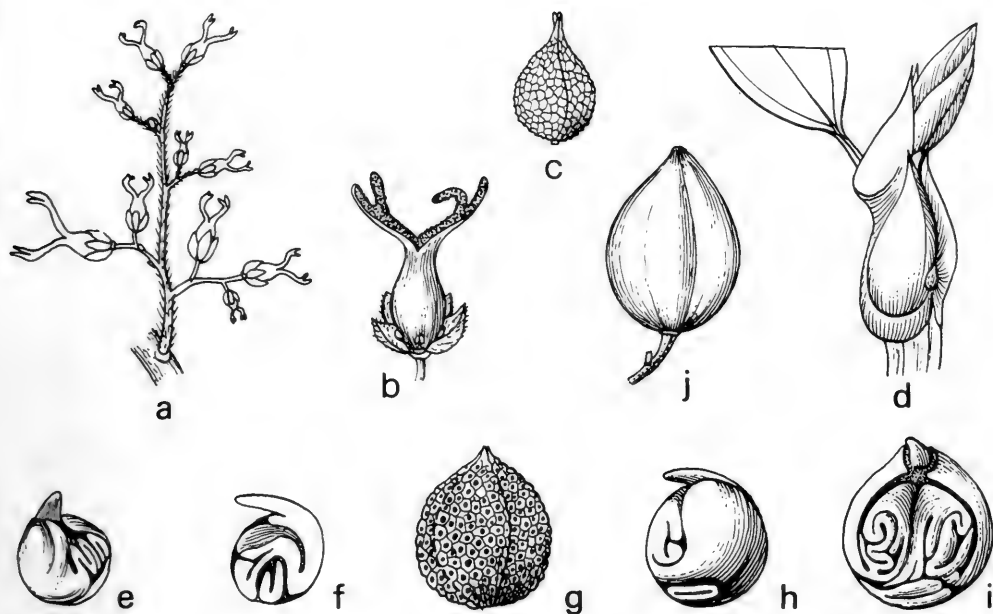


Fig. 20. *Celtis paniculata* (ENDL.) SPACH. a. ♀ Inflorescence, $\times 8$, b. flower, $\times 14$, c. fruit, $\times 1\frac{1}{3}$, d. shoot apex showing terminal bud above 2 pairs of overlapping stipules, $\times 5$. — *C. rigescens* (MIQ.) PLANCH. e. Embryo, folded cotyledons, $\times 1\frac{1}{3}$. — *C. timorensis* SPACH. f. Embryo in LS, $\times 2$. — *C. hildebrandii* SOEPADMO. g. Pitted endocarp, $\times 3$, h-i. embryos, $\times 4$. — *C. latifolia* (BL.) PLANCH. j. Fruit, nat. size (a-b KORNASSI 463, c. KOSTERMANS & SOEGENG 352, d PLEYTE 73, e BLOEMBERGEN 4231, f FORBES 1073, g-i CLEMENS 8375, j BSIP 11768).

to deeply impressed above; main nerves (2-3)(-4) pairs, ascending and arcuating, anastomosing along the margin, the lowest pair running up to $\frac{1}{2}$ - $\frac{3}{4}$ the length of the leaf; reticulations sub-scalariform to subareolate, distinct beneath; petiole 6-10 by 1-2 mm, shallow-sulcate, densely appressed yellowish-brown pubescent, glabrescent. Inflorescence ♂ or ♀ or rarely mixed, $1\frac{1}{2}$ -5 cm long; bracts ovate, c. $\frac{1}{2}$ -1 by $\frac{1}{2}$ mm. — ♂ Inflorescence a much-branched, multiflorous (up to c. 70) panicle up to 5 cm long, axes slender, flexuous, borne on the lower and leafless part of the new shoot or in the axils of lower new leaves; ♂ flower $1\frac{1}{2}$ -2 mm \varnothing , subsessile; perianth lobes (4-5), elliptic, c. $1\frac{1}{2}$ by 1 mm; filaments 1- $1\frac{1}{2}$ mm long, anthers reniform, c. 1 by $\frac{1}{2}$ mm; pistillode minute, surrounded by dense pale yellowish-brown hirsute hairs. In a mixed inflorescence, the few ♀ flowers are situated near the tip of the axis. — ♀ Inflorescences borne in the axils of leaves of the new shoot, 1- $1\frac{1}{2}$ cm long with up to 5 flowers; ♀ flower ovoid, c. 2 by 1 mm; perianth lobes (4-5), elliptic-rounded, c. $1\frac{1}{2}$ by 1 mm, stamens (4-5); filaments c. 1 mm, anthers c. $\frac{1}{2}$ by $\frac{1}{2}$ mm; ovary slightly compressed, densely pale yellowish-brown appressed-hairy; stigmatic arms spreading, bifurcate at the tip. Infructescence up to 2-3 cm long, axes up to 2 mm thick, with (1-2)(-3) fruits. Fruit

ellipsoid, faintly 5-angular, c. 15 by 10 mm, appressed-pubescent, glabrescent; exocarp 2-3 mm \varnothing , rather woody, occasionally lenticellate, turning deep-red when ripe, containing slimy substances when boiled. Embryo curved, cotyledons foliaceous, folded, equal. Endosperm scanty.

Distr. Solomons (common); in *Malesia*: New Guinea (incl. New Britain, common), Moluccas (Ceram, Buru, Sula, Morotai), NE. Celebes (Minahasa), E. Borneo (W. Kutei), W. Java (Bantam), Central & S. Sumatra, Anambas Is., and Malaya (Perak, Selangor, Pahang, Johore).

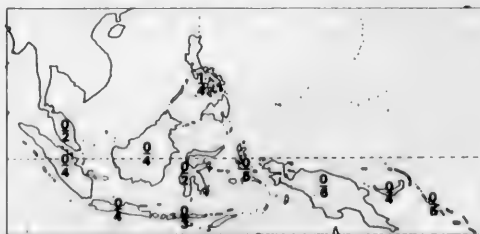


Fig. 21. Species density of *Celtis* L. in *Malesia*; above the hyphen endemic spp., below it the non-endemic ones.



Fig. 22. *Celtis philippensis* BLANCO var. *wightii* (PLANCH.) SOEPADMO at Atasangin, Bodjonegoro (Photogr. WIND, Jan. 1925).

Ecol. In primary and secondary forest, 0–1500 m, on various types of soils including limestone. Often rather common locally (W. New Guinea and Solomons). *Fl.* (March–April) Sept., Dec., fr. Dec.–Aug.

Vern. Malay Peninsula: *mēmpēlas bulan*, Abor., *rēmpēlas*, M. Sumatra: *klutum*, *maršēkan*, *rēmpēlas*, M. Palembang, *asin asin*, Anambas, West New Guinea: *sēhiega*, *sēriega*, Manikiong lang., *wennēmaram*, Berik lang., Hollandia, *bēgēk*, Oransbari, Hattam lang., *pieh(h)*, Kebar, *bipa*, Wandammen lang., Adi I., *ainam*, Key lang., *hajanggij*, *manji*, *sēkika*, Manokwari, *pimar*, Sidei lang., *warēn*, *siempai*, *wiempai*, Biak lang., *walik*, *walis*, Mooi lang.; East New Guinea: *gairama*, *watoi*, Waria dial., Moresby, Madang Distr., *koru*, Bambi, *suri*, Madang, *bagibib*, Kaigorin, *aban*, *bison*, *sam*, Bilia, *baigu(p)*, Amele, *bagibip*, *kara*, *sungung*, *susuik*, Dumpu, *goga*, *mutum*, *sawan*, Faifa, *tapang*, Washuk, Sepik Distr.; *ailee*, Urin, S. New Britain; *gwalafalisi*, *lausi*, Kwara lang., Solomons.

Note. Sterile specimens, especially those with young leaves only, may easily be mistaken as belonging to *Grewia* or *Microcos* (Tiliaceae) or to *Ziziphus angustifolius* (BL.) HATUS.

2. *Celtis luzonica* WARB. in Perkins, *Fragm. Fl. Philip.* (1905) 164; MERR. *En. Philip.* 2 (1923) 32. — *Fig. 23c.*

Tree up to 30 m, 90 cm Ø. Bark smooth yellowish-grey. Innovations sparsely set with minute simple hairs, glabrescent. Terminal bud ovoid, c. 6–10 by 3–5 mm. Stipules ovate, thick, glabrous, peltately attached and overlapping, c. 5–10 by 3–5 mm. *Leaves* broad elliptic to elliptic-oblong, thick-coriaceous, glabrous, (8–)12–16(–19) by (5–)8–10 (–12) cm, index ($1\frac{1}{4}$ – $1\frac{1}{2}$ –2); base rounded, symmetrical; margin entire, undulate, apex rounded with blunt and sometimes emarginate tip; midrib and nerves raised beneath, flattish to shallowly impressed above; nerves 2–3 pairs, ascending and arcuating, at least at an angle of 55° with the midrib, anastomosing and looped along the margin, the lowest pair running up to $\frac{2}{3}$ – $\frac{3}{4}$ the length of the leaf; reticulations irregular to subscalariform, sparse, distinct beneath or obscure on both surfaces; petiole 10–20 by $1\frac{1}{2}$ –2(–3) mm, flat or shallowly sulcate. Flowers 5-merous. *Inflorescences* ♂ or ♂♀, much-branched panicles or racemose, up to 150-flowered, up to 10 cm long, axillary or subterminal, including the bracts sparsely puberulous, glabrescent; bracts ovate, minute, c. 1 by $\frac{1}{2}$ mm. — ♂ *Flower* c. $1\frac{1}{2}$ –2 mm Ø; perianth lobes c. $1\frac{1}{2}$ –2 by 1 mm; filaments $1\frac{1}{2}$ –2 mm, anthers subreniform, c. $1\frac{1}{2}$ –1 by $\frac{1}{2}$ –1 mm; pistillode ovoid-conical, compressed, c. 1 by $\frac{1}{2}$ mm. — ♀ *Flowers* ovoid-conical, borne at the distal parts of the inflorescence, $2\frac{1}{2}$ –3 by 2– $2\frac{1}{2}$ mm; perianth lobes c. $1\frac{1}{2}$ –2 by $1\frac{1}{2}$ –1 mm; filaments c. $1\frac{1}{2}$ –2 mm, anthers c. $\frac{3}{4}$ by $\frac{1}{2}$ mm; ovary ± compressed, sparsely pubescent apically, c. 2– $2\frac{1}{2}$ by $1\frac{1}{2}$ –1 mm; stigmatic arms spreading or incurved, broadened and shallowly bifid at the tip. *Infructescence* with a stout axis 2–3 mm thick, bearing up to 10 fruits. *Fruit* globose, glabrous, 16–20 by 14–18 mm, ± terete, reddish-brown when ripe; endocarp 4-lobed and splitting at maturity; embryo curved, hypocotyle ascending, cotyledons foliaceous, equal,

folded; endosperm very scanty to nearly absent.

Distr. *Malesia*: Philippines (Luzon, Surigao, Mindanao, Mindoro, Samar, Masbate).

Ecol. In thickets and forests at low altitude. *Fl. fr.* March–July.

Vern. Philippines: *malaikmo*, *malaikmo*, Tag., *daloo*, Todaya.

3. *Celtis paniculata* (ENDL.) PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 305; in DC. *Prod.* 17 (1873) 182; BTH. *Fl. Austr.* 6 (1873) 156; NADEAUD, *En. Pl. Tahiti* (1873) 42; LAUT. *Bot. Jahrb.* 50 (1913) 310; KANEH. *Fl. Micron.* (1933) 82, f. 14; FRANCIS, *Austr. Rain-forest Trees* ed. 2 (1951) 67. — *Solenostigma paniculatum* ENDL. *Prod. Fl. Norf.* (1833) 42. — *C. pacifica* PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 308; in DC. *Prod.* 17 (1873) 184. — *C. ingens* F.v.M. *Fragm.* 4 (1864) 88. — *C. vitiensis* A. C. SMITH, *Bull. Torr. Bot. Cl.* 70 (1943) 536; J. Arn. *Arb.* 31 (1950) 150; PARHAM, *Pl. Fiji Isl.* (1964) 88. — *Fig. 20a–d, 23i.*

Small to large tree, up to 36 m, 70 cm Ø. Buttresses occasionally present, up to $1\frac{1}{4}$ m. Bark smooth to finely fissured, light- to dark-brown. Innovations sparsely appressed-puberulous, glabrescent. Older twigs glabrous, sparsely lenticellate. Stipules overlapping, embracing the twig and enclosing the bud, broad-ovate-acute, thick, c. 4–5 by 3–4 mm. *Leaves* elliptic to ovate-elliptic, (5–)8–11(–13) by ($2\frac{1}{2}$ –)3–5(–6) cm, index ($1\frac{1}{2}$ –)2 (– $2\frac{1}{2}$); coriaceous, glabrous, dull grey-green when dried; base attenuate-rounded, mostly symmetrical, margin entire, often undulate, apex bluntly acute to rounded-acute; midrib and nerves only slightly raised beneath, flattish to shallowly impressed above; main nerves 3–5 pairs, ascending and arcuating at an angle of over 50° with the midrib, anastomosing and looped along the margin, the lowest pair running up to $\frac{1}{3}$ – $\frac{1}{2}$ the length of the leaf; reticulations fine, irregular, obscure on both surfaces; petiole 6–15 by $1\frac{1}{2}$ –1 mm, flat to ± sulcate. Flowers 5-merous. *Inflorescences* ♂ or ♀ or rarely mixed, axillary or subterminal, much-branched, 5–60-flowered, including the bracts sparsely appressed-puberulous; bracts ovate-acute, c. 2 by 1 mm. — ♂ *Inflorescences* up to 4 cm long, borne on the lower and leafless part or axillary on the lower leaf of the new shoot, paniculate, 30–60-flowered; ♂ flowers subsessile, c. $1\frac{1}{2}$ –1 mm Ø; perianth lobes transparent, c. $1\frac{1}{2}$ –1 by $\frac{1}{2}$ mm; filaments c. 1 mm, anthers subreniform, c. $\frac{3}{4}$ –1 by $\frac{1}{2}$ mm; pistillode minute, compressed. — *Mixed* or ♀ *inflorescences* axillary on the upper parts of the new shoot, racemose, 5–10-flowered; ♀ flower ovoid-conical, c. 2 by 1 mm; perianth lobes ovate-acute, c. $\frac{1}{2}$ –1 by $\frac{1}{2}$ mm, subglabrous; staminodes rudimentary, very much shorter than the perianth; ovary ± compressed, subglabrous, c. $1\frac{1}{2}$ –2 by 1 mm; stigmatic arms spreading, bifid at the tip. *Fruit* ovoid, faintly 4–5-angular, beaked, glabrous, 7–12 by 5–8 mm, bluish to glaucous when ripe, mostly sterile.

Distr. Australia (Queensland, Norfolk I.), Melanesia (Solomons, New Hebrides, New Caledonia), Polynesia (Fiji, Tonga, Tahiti, Cook Is., Pitcairn, Mangarawa I., Tuamotus, Marquesas), Micronesia (Marianas); in *Malesia*: Lesser Sunda Islands (Wetar), Borneo (Mt Kinabalu, very rare), Moluccas (Morotai, Ceram, Ambon, Tanimbar),

New Guinea (common in West, apparently rare in East).

Ecol. Primary and secondary forest, 0–900 m, on well drained soils including coral limestone, very often common locally (W. New Guinea and Solomons). *Fl. fr.* July–May.

Vern. New Guinea: *wiempai*, Biak, *sēhiega*, Manikiong; Solomons: *lausiasi*, Kwara; Fiji: *marasa*, Sabalu.

4. *Celtis philippensis* BLANCO, *Fl. Filip.* (1837) 197; *PLANCH. Ann. Sc. Nat.* III, 10 (1848) 306; in *DC. Prod.* 17 (1873) 184 (*'philippinensis'*); *BTH. Fl. Austr.* 6 (1873) 156; VIDAL, *Rev. Pl. Vasc. Filip.* (1886) 248; MERR. *Philip. J. Sc.* 1 (1906) Suppl. 42; Sp. Blanc. (1918) 122; *En. Philip.* 2 (1923) 32; LEROY, *Bull. I.F.A.N.* 10 (1948) 212, incl. *var. consimile* (BL.) LEROY; *Fl. Madag. Fam.* 54 (1952) 3; SOEPADMO in Whitmore, *Tree Fl. Mal.* 2 (1973) 416. — *C. wightii* PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 307; WIGHT, *IC. Pl.* (1853) t. 1969; PLANCH. in *DC. Prod.* 17 (1873) 184; HOOK. *f. Fl. Br. Ind.* 5 (1888) 483; BRANDIS, *Ind. Trees* (1906) 594; J. J. SMITH in K. & V. *Bijdr.* 12 (1910) 647; GAGNEP. *Fl. Gén. I.-C.* 5 (1927) 683; POLHILL, *Kew Bull.* 19 (1964) 141; BACK. & BAKH. *f. Fl. Java* 2 (1965) 11. — *C. strychnoides* PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 306; in *DC. Prod.* 17 (1873) 185; WARB. *Bot. Jahrb.* 13 (1891) 287; LAUT. in K. Sch. & Laut. *Fl. Schutzgeb.* (1900) 264. — *C. mauritiana* PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 307; in *DC. Prod.* 17 (1873) 184. — *Sponia strychnifolia* TEYSM. & BINN. *Nat. Tijd. N. I.* 4 (1853) 394; Ned. *Kruidk. Arch.* 3 (1855) 392. — *Solenostigma brevinerve* BL. *Mus. Bot.* 2 (1856) 67. — *Solenostigma laurifolium* BL. *l.c.* 68; *Miq. Fl. Ind. Bat.* 1, 2 (1859) 220, incl. *var. constricta* *Miq.* — *Solenostigma hasseltii* BL. *Mus. Bot.* 2 (1856) 68. — *Solenostigma consimile* BL. *l.c.* 68. — *Solenostigma djungiel* BL. *l.c.* 69. — *Solenostigma philippinensis* (BLANCO) *Miq. Fl. Ind. Bat.* 1, 2 (1859) 220. — *Solenostigma wightii* (PLANCH.) *Miq. l.c.* 220. — *C. brevinervis* (BL.) PLANCH. in *DC. Prod.* 17 (1873) 183. — *C. laurifolia* (BL.) PLANCH. *l.c.* 185. — *C. hasseltii* (BL.) PLANCH. *l.c.* 185. — *C. djungiel* (BL.) PLANCH. *l.c.* 185. — *C. mindanaensis* ELMER, *Leaf. Philip. Bot.* 8 (1915) 2842. — *C. collinsae* CRAIB, *Kew Bull.* (1918) 370; RIDL. *Fl. Mal. Pen.* 3 (1924) 322. — *C. multifolia* ELMER, *Leaf. Philip. Bot.* 10 (1939) 3796, *angl., inval.* — **Fig. 18a–k, 22.**

Small to large tree, up to 30 m, 80 cm Ø. Buttresses if present up to 2½ m tall, 2 m wide and 10 cm thick. Bark smooth to finely fissured, pale grey to grey-brown. Innovations initially sparsely to densely set with yellowish-brown appressed or/and woolly hairs, glabrescent. Stipules ovate-acute, 6–10 by 2–4 mm, thick, peltately attached, overlapping and enclosing the bud. *Leaves* thick-coriaceous, glabrous, full grey when dried, elliptic-oblong to suborbicular, (4–)8–14(–18) by (2–)3–6(–8) cm, index (1½–)2–3; base rounded or attenuate-rounded, mostly symmetrical; margin entire often undulate (immature leaves very rarely distantly serrulate at the upper half); apex rounded to acute; midrib and nerves raised beneath, impressed to flatish above; main nerves 1 pair, ascending, arcuating and running throughout the length of the leaf (*var. philippensis*) or 1–3 pairs, the lowest pair ascending, arcuating, and running

up to about ⅔ the length of the leaf and then anastomosing with the 1–2 weaker and more or less horizontal upper nerves (*var. wightii*); reticulations fine, dense, subscalariform or subareolate, usually rather distinct beneath; petiole 6–15 by 1–2 mm, sulcate. *Inflorescences* ♂ or ♂♀, much-branched panicles, many-flowered, including the bracts densely yellow-brown to rufous soft-hairy; bracts ovate-acute, c. 3 by 1 mm. In the ♂♀ inflorescence the ♀ flowers are borne on the distal parts of the inflorescence. — ♂ *Inflorescences* borne on the lower part of the new shoots, 2–4 cm long, with up to 40 flowers; ♂ flowers c. 2 mm Ø; perianth lobes ovate-elliptic, c. 1½–2 by 1 mm; filaments 1–1½ mm long, anthers subreniform, c. ½–1 mm by ½ mm; pistillode ovoid-cylindrical, compressed, c. 1–1½ by ½ mm. — *Mixed inflorescence* up to 5 cm long, up to 50-flowered, borne on the upper part of the new shoots; ♀ flowers ovoid, c. 2–2½ by 2 mm; perianth lobes ovate-elliptic, c. 2–2½ by 1 mm; filaments 1–2 mm, anthers ½–1 mm Ø; ovary ovoid-cylindrical, c. 2–2½ by 1½–2 mm, glabrous except at the base; stigmatic arms spreading, c. 1–1½ mm long, bilobed to bifid at the tip. *Infructescence* up to 4–5 cm long, carrying 1–3 fruits, axes 1–2 mm thick. *Fruit* ovoid, glabrous, 8–15 by 7–12 mm, beaked when young; exocarp less than 1 mm Ø, sometimes lenticellate, turning orange to red when ripe; endocarp ± smooth; embryo curved, hypocotyle ascending, cotyledons broad, foliaceous, unequal in thickness, not folded; endosperm oily, scanty to absent.

Distr. Tropical Africa to Madagascar, Indian Ocean (Réunion, Mauritius, etc.), India, Burma, ? SE. China, Hongkong, Taiwan, Indo-China, Thailand, throughout Malesia to NE. Australia and the Solomons.

Taxon. A rather variable, widely spread species with two rather but not completely distinct varieties. These are:

a. *var. philippensis*, characterized by larger leaves of (7–)9–12(–18) by 4–8 cm with one pair of nerves usually running more or less throughout the length of the leaf, subscalariform reticulation, and larger fruit of 10–15 by 8–12 mm;

b. *var. wightii* (PLANCH.) SOEPADMO, *comb. nov.* (basionym: *C. wightii* PLANCH. *l.c. supra*). Fig. 22. Characterized by smaller leaves, (4–)5–7(–9) by (2–)3–4(–5½) cm with 1–3 pairs of nerves and the lowest pair mostly running up to ⅔ the length of the leaf, and slightly smaller fruit, 8–12 by 6–10 mm.

It should be noted, that the distinguishing characters mentioned above should be applied in combination; if taken individually they may not be clearly well defined. For example, there are several specimens (e.g. GARDNER *s.n.*, THWAITES CP 50 from Ceylon; KING *s.n.* and BROWNE *s.n.* from India; PARKINSON 214 from the Andamans; UNESCO 214 from Malaya; JACOBS 4709, 4711, and KOSTERMANS 23061 from Java; KOSTERMANS & WIRAWAN 61 from the Lesser Sunda Is.; NGF 19100 & 30787 from New Guinea; MERRILL Sp. Blanc. 52 from the Philippines, etc.) which have both types of venation. As for the fruit, the smaller size in *var. wightii* may be due in part to the fact that they are not fully ripe, as the majority of them are empty (without embryo). Furthermore, it was also noticed that most specimens of *var. wightii*

have been collected from localities under a strong seasonal climate or from trees growing on well-drained and poor soils (rocky or sandy beach, limestone hills, etc.).

Ecol. Understorey tree in primary and secondary forests, on various types of soils, at low altitudes (0–650 m); often gregarious and very common locally. *Fl. fr.* mostly July–April. The fruits which turn to orange or red when ripe may be dispersed by birds, but in the case of *var. wightii*, which mostly grows in the very coastal forest, they may be dispersed by sea-water as well; (the endocarp is woody, hard, and persistent).

Uses. Though not durable, the wood is locally used for house-building.

Vern. Java: *ki-ëndog*, *ki-howè*, S. W. Java, *kèraja*, *pusutan*, *sèntok*, *sèpat*, *sèprèh*, *tjèngkèk*, *wuluh*, J. Central & E. Java; N. Borneo: *nyelepi*; Philippines: *malaitmo*, *narabagsay*, Tag.; Celebes: *kao lulu*, Malili; Moluccas: *horo*, Morotai; Lesser Sunda Is.: *menulang*, Sumba, *nemu*, Flores; New Guinea: *pièh*, Kebar, *marmar*, Tor, Berik, *sehiega*, Manikiong, *bèpiejèt*, Hattam, *warèn*, Biak, *ikai*, *ikoi*, Kemtuk, *mèlawar*, Mooi, etc.

5. *Celtis latifolia* (BL.) PLANCH. in DC. Prod. 17 (1873) 186; **WARB.** Bot. Jahrb. 13 (1891) 287; **LAUT.** in K. Sch. & Laut. Fl. Schutzgeb. (1900) 264; Bot. Jahrb. 50 (1913) 311. — *Solenostigma latifolium* BL. Mus. Bot. 2 (1856) 67; **MIQ.** Fl. Ind. Bat. 1, 2 (1859) 219. — *Solenostigma zippelii* BL. Mus. Bot. 2 (1856) 67. — *C. zippelii* (BL.) PLANCH. in DC. Prod. 17 (1873) 186. — *C. kajewskii* MERR. & PERRY, J. Arn. Arb. 22 (1941) 254. — Fig. 20j, 23k.

Tree up to 35 m, 80 cm Ø. Buttresses plank-like, up to 2 m tall, 2½ m out and 6 cm Ø. Bark smooth to finely fissured, pustulate-lenticellate, light-brown to grey-brown. Innovations densely yellowish-brown hairy, glabrescent. Young twigs blackish when dry, older ones greyish, glabrous and sparsely lenticellate. Terminal buds ovoid-conical, acute, 10–15 by 4–5 mm. Stipules peltately attached, overlapping, thick, ovate-acute, c. 10 by 5 mm. Leaves thick-coriaceous, glabrous or sparsely pubescent beneath, especially on midrib and nerves, broadly ovate to elliptic-orbicular, (8–)15–18(–25) by (6–)8–12(–18) cm, index 1½–2½; base rounded to subcordate, symmetrical to ± asymmetrical; margin entire, undulate, often recurved; apex bluntly rounded or acute to acuminate; midrib and nerves strongly raised beneath, impressed above; nerves 1–2 pairs, ascending and arcuating, the lowest pair running through ¾ of the length of the leaf; reticulations coarse, wide-spaced, subscalariform, distinct beneath; petiole 10–20 by 2–3 mm, glabrous, shallowly sulcate. Flowers 5-merous. *Inflorescence* ♂ or ♀, axillary or borne on the lower part of the new shoot, 10–30-flowered, including the bracts densely yellowish-brown appressed-hairy; bracts ovate, c. 2 by 1 mm. — ♂ *Inflorescence* (not fully developed) up to 2 cm long, 15–30-flowered, paniculate; ♂ flowers c. 1½–2 mm Ø; perianth lobes c. 1½–2 by 1 mm; filaments c. 1 mm, anthers c. ½–1 by ½ mm; pistillode compressed ovoid, c. 1 by ½ mm. — ♀ *Inflorescence* racemose, 5–10-flowered, slender, up to 7 cm long, few-branched; ♀ flower ovoid-ellipsoid, borne on the distal part of the inflorescence, c. 2–3 by 2 mm; perianth lobes ovate-lanceolate,

c. 2–2½ by 1 mm, at anthesis recurved; filaments up to 1½ mm, anthers c. ½–¾ by ½ mm; ovary ovoid-cylindrical, c. 2–3 by 1–1½ mm, initially densely appressed-hairy, glabrescent except for the basal part; stigmatic arms spreading, shallowly bilobed at the tip. *Inflorescence* up to 5 cm long, carrying 1–5 fruits, axes sturdy c. 2–3 mm thick. *Fruit* ovoid, faintly 4–5-angular, glabrous, 1½–2½ by 1–1¾ cm, exocarp occasionally lenticellate, up to 2 mm Ø, turning to orange or deep-red when mature. Embryo curved, cotyledons fleshy, unequal in thickness, hypocotyle ascending; endosperm absent.

Distr. Solomons (very common); in *Malesia*: Philippines (Palawan), Moluccas (Morotai, Tidore), and New Guinea (in West very common in the vicinity of Manokwari and Hollandia; in East in Sepik and Morobe Districts; New Britain).

Ecol. Primary and secondary forests on sandy clay soils, 0–400 m. *Fl. fr.* mostly Jan.–Aug.

Vern. Moluccas: *tohu*, Morotai; New Guinea: *sehiega*, Manikiong, *marmar*, Berik, *bepiet*, Hattam; Solomons: *lae-lae*, Kwara.

6. *Celtis hildebrandii* SOEPADMO, sp. nov. — Fig. 20g–i, 23l.

Species valde affinis C. philippensi var. *philippensi* et *C. latifoliae*, sed ab eis differt folio asymmetrico, inflorescentia ♂ valde ramosa multiflora, et cotyledonibus multiplicatis. T: BW 7936.

Arbor magna usque ad 45 m alta et 1 m diam. Folia tenuiter coriacea, oblique ovato-elliptica, (5–)8–11(–14) × (3–)4–6(–8) cm, ind. 1.5–2, glabra, nervis lateralibus uniparibus usque ad ¼ partem laminae longitudinis ascendentibus, reticulatione laxa subscalariformi; petiolus applanatus vel ± sulcatus, 8–15 × 1–1.5 mm. Inflorescentiae ♂ et ♀; ♂ multiramosae, 60–150-florae; ♀ 5–10-florae. Fructus ovoideo-globosus, ± 4– vel 5-angulatus, 10–12 × 8–10 mm; endospermium nullum; cotyledones multiplicati; embryo curvatus.

Large tree up to 45 m, 100 cm Ø. Buttresses up to 2½ m tall, 2 m out and 10 cm Ø. Bark smooth to finely fissured, often pustulate, light-brown to grey-brown. Innovations densely rufous to yellowish-brown appressed-hairy, glabrescent. Terminal buds ovoid-conical, acute, c. 4–6 by 3 mm. Stipules ovate-acute, peltately attached and overlapping, thick, c. 5 by 3 mm. Leaves thin-coriaceous, obliquely ovate-elliptic, (5–)8–11(–14) by (3–)4–6(–8) cm, index 1½–2; glabrous; often discolorous, upper surface dull grey-green, lower surface dull chocolate- or grey-brown; base attenuate-rounded, mostly asymmetrical; margin entire, often undulate; apex acute to acuminate; midrib and main lateral nerves raised beneath, impressed or flattish above; nerves one pair, ascending and arcuating, running up to ¼, or the entire length of the leaf; reticulations lax, subscalariform, rather distinct beneath; petiole glabrous, 8–15 by 1–1½ mm, flat, ± sulcate. *Inflorescence* ♂ or ♀, axillary or subterminal on new shoots, much-branched, many-flowered, including the bracts rather densely yellowish-brown to rufous appressed-hairy, glabrescent; bracts ovate-acute, c. 2–3 by 1–1½ mm. Flowers 5-merous. — ♂ *Inflorescences* much-branched panicle, 60–150-flowered; ♂ flower c. 2 mm Ø; perianth lobes c. 1½–2 by 1 mm; filaments 1–1½

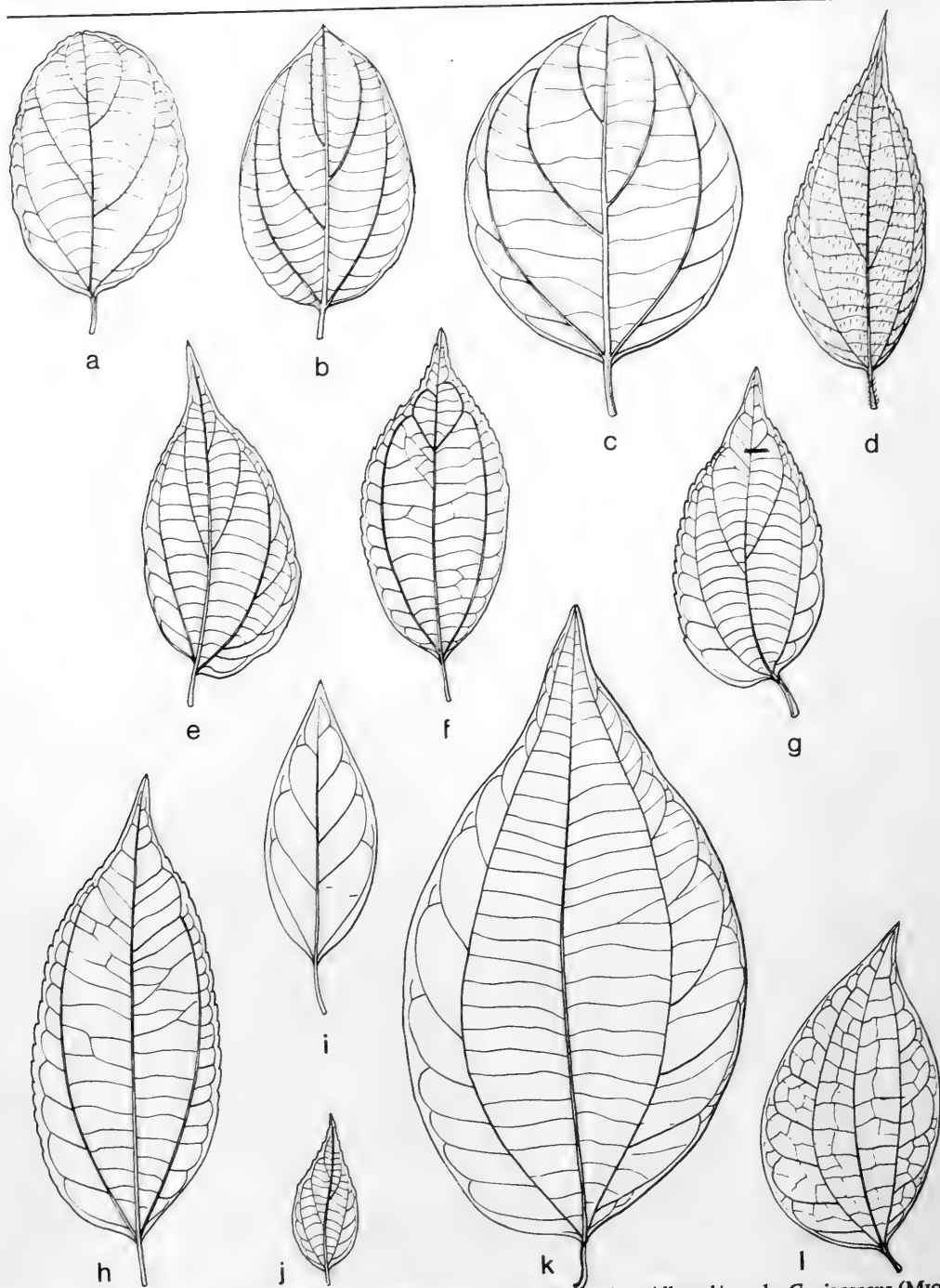


Fig. 23. Leaf shape and venation of some Malesian *Celtis* species. All $\times 1/2$. a-b. *C. rigescens* (MIQ.) PLANCH. — c. *C. luzonica* WARB. — d-e. *C. tetrandra* ROXB. — f-h. *C. timorensis* SPAN. — i. *C. paniculata* (ENDL.) PLANCH. — j. *C. rubrovenia* ELMER. — k. *C. latifolia* (BL.) PLANCH. — l. *C. hildebrandii* SOEPADMO (a-b bb T.1012, c BS 1633, d KOORDERS 8771, e KOORDERS 26516, f KOORDERS 38755, g JUNGHUHN s.n., h BLUME s.n., i bb 33845, j BRASS & VERSTEEGH 11168, k LAM 3635, l BRASS 28860).

mm, anthers subreniform, c. $\frac{3}{4}$ –1 by $\frac{1}{2}$ mm; pistillode ovoid-cylindrical, compressed, c. $\frac{3}{4}$ by $\frac{1}{2}$ mm. — ♀ *Inflorescence* a much-branched raceme, up to 4–5 cm long, 5–10-flowered; ♀ flower ellipsoid, c. 3 by 2 mm; perianth lobes ovate-acute, c. 2–3 by 1 mm; filaments 1–1½ mm, anthers c. $\frac{1}{2}$ by $\frac{1}{2}$ mm; ovary ovoid-ellipsoid, c. 2 by 1 mm, slightly compressed, initially densely hairy, glabrescent; stigmatic arms initially curved, later spreading, c. 1–1½ mm long, broadened and shallowly bilobed at the tip. *Infructescence* 3–5 cm long, axes glabrous, c. 1–2 mm Ø, bearing 2–5 fruits. *Fruit* ovoid-globose, glabrous, \pm 4–5-angular, slightly beaked, 10–12 by 8–10 mm; exocarp thin, endocarp pitted; embryo curved, hypocotyle ascending, cotyledons broad, foliaceous, folded; endosperm absent.

Distr. Solomons (common); in *Malesia*: Moluccas (Buru, rare), New Guinea (W. & E. parts, common; New Britain).

Ecol. In both primary and secondary forests at 0–1000 m; often very common and gregarious locally; on various types of soil. Male flowers appear with new shoots around Nov.–Dec., and ♀ ones around Jan.–Feb.; fruits mature by May–June. The ripe fruits, which turn deep purple or bluish black, may be dispersed by birds.

Vern. New Guinea: *bēhēg*, Hattam, *walik*, Mooi, *sehiega*, Manikiong, *piēh*, Kebar, *biempai*, Biak; Solomons: *laussi*, *lai-lai*, Kwara.

7. *Celtis timorensis* SPAN. Linnaea 15 (1841) 343; PLANCH. Ann. Sc. Nat. III, 10 (1848) 315; BL. Mus. Bot. 2 (1856) 71; MIQ. Fl. Ind. Bat. 1, 2 (1859) 22; PLANCH. in DC. Prod. 17 (1873) 180. — *C. cinnamomea* LINDL. ex PLANCH. Ann. Sc. Nat. III, 10 (1848) 303; BL. Mus. Bot. 2 (1856) 72; PLANCH. in DC. Prod. 17 (1873) 181; KURZ, For. Fl. Burma 2 (1877) 472; HOOK. f. Fl. Br. Ind. 5 (1888) 482; PRAIN, Beng. Pl. 2 (1903) 719; BRANDIS, Ind. Trees (1906) 596; J. J. SMITH in K. & V. Bijdr. 12 (1910) 644; MERR. En. Philip. 2 (1923) 32; GAGNEP. Fl. Gén. I.-C. 5 (1927) 682; BACK. & BAKH. f. Fl. Java 2 (1965) 11. — *C. reticulosa* MIQ. Pl. Jungh. (1851) 69; Fl. Ind. Bat. 1, 2 (1859) 222. — *C. hamata* BL. Mus. Bot. 2 (1856) 72; PLANCH. in DC. Prod. 17 (1873) 180. — *C. waitzii* BL. Mus. Bot. 2 (1856) 71; MIQ. Fl. Ind. Bat. 1, 2 (1859) 221; PLANCH. in DC. Prod. 17 (1873) 180. — *C. dysodoxylon* THW. En. Pl. Zeyl. (1861) 267. — *C. crenato-serrata* MERR. Philip. J. Sc. 5 (1910) Bot. 174. — Fig. 20f, 23f–h.

Medium-sized tree up to 20 m, 30 cm Ø. Bark smooth, grey. Innovations densely rufous-hairy. Branchlets glabrous, rather densely lenticellate. Terminal buds ovoid-conical, c. 3–4 by 2 mm. Stipules linear-lanceolate, 5–10 by 1–2 mm. *Leaves* thin-coriaceous, ovate-elliptic to elliptic-oblong, (6–)10–12(–17) by (2½–)4–5(–8) cm, index 1½–2½; except for the midrib and nerves glabrous, discolorous, upper surface dull grey to blackish, lower surface chocolate-brown; base rounded to subcordate, mostly asymmetrical, margin undulate, distantly serrulate to crenate at least for the upper half; apex acute to acuminate; midrib and nerves flattish to impressed above, raised beneath; nerves 1–2(–3) pairs, arcuating and ascending, the lowest pair running to (½–)⅓(–¼) the length of the leaf, anastomosing along the margin; reticulations

subscalariform, sparse, rather distinct beneath; petiole 5–15 by 1–2 mm, sulcate. Flowers 5-merous. *Inflorescence* ♂ or ♂ ♀, racemose, lax, axes slender, always longer than the petiole, including the bracts sparsely rufous-hairy; bracts narrow ovate-acute, c. 3–5 by 1–2 mm. — ♂ *Inflorescences* borne on the lower and leafless parts of the new shoots, much-branched, 10–20-flowered, up to 3 cm long; ♂ flower c. 2 mm Ø; perianth lobes c. 1½–2 by 1 mm; filaments 1–1½ mm, anthers reniform, c. 1 by ½ mm; pistillode present but strongly reduced in size. — ♀ *Inflorescences* borne in the axils of new leaves, 4–7-flowered, up to 2–3 cm long; ♀ flower c. 2–3 mm Ø; perianth lobes c. 1½–2 by 1 mm; filaments c. ½–1 mm, anthers subreniform, c. ½–¾ by ½ mm; ovary ovoid-ellipsoid, c. 2 by 1 mm; stigmatic arms c. 1–1½ mm, spreading. *Infructescence* up to 4–5 cm long. *Fruit* ovoid, terete or 4-angular, beaked, 5–10 by 3–6 mm, glabrous. Embryo curved, hypocotyle ascending; cotyledons broad, folded, equal; endosperm scanty.

Distr. Ceylon, India, Bangladesh, Burma, Thailand, Indo-China; in *Malesia*: Central Sumatra (rare), Java (common; incl. Christmas I.), Lesser Sunda Islands (Flores, Timor), N. Borneo (Mt Kinabalu), Philippines (Luzon).

Ecol. Outside *Malesia* the species grows in evergreen forests or along streams in deciduous forests. In *Malesia* it is more common in areas with a rather prominent seasonal climate, 0–1500 m. *Fl. fr.* Nov.–April.

Vern. Central Sumatra: *ki tondok*, *si tjakik*; Java: *jeungil*, *ki tamiang*, *S*, *tjengkèk*, *tjitik*, *J*; Philippines: *takulao*, *Ibn.*, *malabutulan*, *Tag*.

8. *Celtis rubrovenia* ELMER, Leaf. Philip. Bot. 2 (1908) 464; MERR. En. Philip. 2 (1923) 33. — *C. similis* MERR. & PERRY, J. Arn. Arb. 22 (1941) 253. — Fig. 23j.

Deciduous tree up to 30 m, 60 cm Ø. Bark grey-brown, smooth. Innovations densely rufous appressed-hairy, glabrescent. Older branchlets glabrous, sparsely lenticellate. Buds ovoid-conical, c. 3 by 2 mm, bracts ovate, imbricate, c. 1 by ½ mm. Stipules subulate, c. 3–4 by 1 mm. *Leaves* (fully developed ones) thick-coriaceous, rigid, brittle, ovate to ovate-elliptic, (3–)4–5(–6½) by (1¼–)1½–2½(–3½) cm, index 2–3.3; sparsely appressed-hairy especially on the midrib and nerves, glabrescent; base attenuate-rounded to rounded, symmetrical to asymmetrical; margin of young leaves serrate to crenate at least at the upper half, that of old leaves entire or distantly serrate in the upper half only; apex acute, acuminate to caudate, tip usually very sharp; midrib and nerves strongly raised beneath (reddish in fresh specimens), impressed above; nerves (1–)2(–3) pairs, arcuating, ascending, at a narrow angle with the midrib less than 45°, lowest pair running to c. ⅓ the length of the leaf; reticulations fine, subareolate, obscure on both surfaces; petiole (3–)4–6(–8) by 1 mm, deeply sulcate. Flowers 4-merous. *Inflorescences* ♂ or ♂ ♀, racemose, 1–2 cm long, 4–7-flowered. — ♂ *Inflorescence* borne on the lower and leafless parts of the new shoot, 5–7-flowered; ♂ flower c. 2 mm Ø; perianth lobes c. 1½ by 1 mm, ciliate; filaments 1–1½ mm long, anthers reniform, c. 1 by ¾ mm; pistillode minute. — *Mixed* (♂ ♀) *inflorescences* 4–5-flowered, borne in the axil of

new leaves; ♀ flower borne on the upper part of the inflorescence, c. 2–2½ mm Ø; perianth lobes c. 1½–2 by 1 mm, ciliate; stamens slightly smaller in size than those of the ♂ flower; ovary ovoid, 1½–2 by 1 mm, densely hirsute; stigmatic arms spreading, 1½–2 mm long. *Infructescences* up to 1½ cm long, carrying (1–)2(–3) fruits. *Fruit* globose, c. 3 by 3 mm, glabrous, ± 4-angular. Endosperm scanty, oily, transparent. Embryo curved, hypocotyle ascending; cotyledons equal, foliaceous, folded.

Distr. *Malesia*: Philippines (Luzon), New Guinea (Kabar Valley, Baliem R.; Morobe Distr.).

Ecol. In primary forests on hills, ridges between 500–1800 m. In New Guinea sometimes rather common locally. *Fl. fr.* Sept.–March.

Vern. Philippines: *palek*; W. New Guinea: *dotjoni*, *nitjoni*, Kabar.

9. *Celtis tetrandra* ROXB. *Fl. Ind. ed. Carey* 2 (1832) 63; PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 300; in DC. *Prod.* 17 (1873) 179; KURZ, *For. Fl. Burma* 2 (1877) 472; GAMBLE, *Man. Ind. Timb.* ed. 1 (1881) 344; HOOK. *f. Fl. Ind.* 5 (1888) 482, *incl. var. hamiltonii* HOOK. *f. et var. mollis* (PLANCH.) HOOK. *f.*; PRAIN, *Beng. Pl.* 2 (1903) 719; BRANDIS, *Ind. Trees* (1906) 596; J. J. SMITH in K. & V. Bijdr. 12 (1910) 641; GAGNEP. *Fl. Gén. I.-C.* 5 (1927) 681; BACK. & BAKH. *f. Fl. Java* 2 (1965) 11. — *C. trinervia* ROXB. *Fl. Ind. ed. Carey* 2 (1832) 65, *non* LAMK, 1797. — *C. acata* HAMILT. *Trans. Linn. Soc.* 17 (1834) 211; PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 299. — *Sponia tetrandra* (ROXB.) VOIGT, *Hort. Suburb. Calc.* (1845) 294. — *C. napalensis* PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 298. — *C. glabra* PLANCH. *l.c.* 298. — *C. roxburghii* PLANCH. *l.c.* 302. — *C. hamiltonii* PLANCH. *l.c.* 301; in DC. *Prod.* 17 (1873) 179. — *C. mollis* PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 297, *p.p.*, *quoad specim. ex Wallich* 7203; in DC. *Prod.* 17 (1873) 179. — *C. serotina* PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 301; WIGHT, *l.c.* 4, 4 (1850) t. 1570. — **Fig. 181–o, 23d–e.**

Semi-deciduous tree up to 40 m and 100 cm Ø. Bark smooth to rough, grey-brown. Innovations densely rufous-hairy, glabrescent. Terminal bud ovoid-globose, 2–3 mm Ø. Stipules linear, c. 5 by 1 mm. *Leaves* coriaceous, oblique ovate-elliptic, (4–)6–10(–13) by (1½–)2½–3½(–5) cm, index 2–3, broadest at or below the middle; slightly discolorous, above glabrous, dull grey in drying, beneath glabrous or sparsely rufous-pubescent especially on midrib and nerves, yellow grey-green in drying; base rounded-attenuate, strongly asym-

metrical; margin denticulate or distinctly serrate at the upper half, or subentire; apex acute, acuminate, to caudate; midrib and nerves flat to impressed above, raised beneath; nerves 3–4 pairs, ascending and arcuating, anastomosing near the margin, the lowest pair running to c. ⅓–⅔ the length of the leaf; reticulations fine, subscalariform, rather distinct beneath; petiole 5–12 by 1–2 mm; slightly sulcate. *Inflorescence* ♂ or ♀, cymoid, including the bracts densely rufous-hairy. — ♂ *Inflorescence* borne on the lower and leafless part of the new shoot, 2–5-flowered, occasionally several of them are clustered together on leafless short lateral new shoots giving rise to a raceme of cymes; ♂ flower c. 2–3 mm Ø; perianth lobes 4(–)5, c. 1½–2 by 1 mm, ciliate; filaments ½–1 mm, anthers reniform, c. 1 by ½ mm, sparsely sericeous; pistillode very much reduced. — ♀ *Inflorescences* 2–5-flowered, axes slender, in the axils of new leaves; ♀ flower c. 2 mm Ø; perianth lobes ciliate, c. 2 by 1 mm; stamens as in the ♂ flower; ovary ovoid, c. 2 by 1 mm, sparsely minute pubescent; stigmatic arms c. 2 mm long, ½ mm broad, spreading. *Fruit* ± globose, 5–8 mm Ø, glabrous, turning deep-red or black when ripe. Endosperm scanty.

Distr. India, Bangladesh, Burma, Thailand, Indo-China; in *Malesia*: N. Sumatra (Gajo and Karo Lands) Java (West: G. Galunggung; Central: G. Muria; East: Bodjonegoro, Mts Kawi & Idjen, Besuki, etc.), Lesser Sunda Islands (Bali, Sumbawa, Flores).

Ecol. In primary and secondary forests, 0–2000 m. In Burma and Thailand very often in evergreen or semi-deciduous forest along river-banks. In *Malesia* the preference seems to be largely to areas subject to a seasonal climate. *Fl. fr.* Aug.–April.

Vern. Sumatra: *ndokum*, *sigar*, Karo, *bitatar*, Toba, *tèmung*, M; W. Java: *ki djeungkil*, *ki tamiang*, S, *tèritih*, *tritih*, J; Lesser Sunda Is.: *pusu*, Sumbawa, *namut*, Flores.

Excluded

Celtis grewioides WARB. *Bot. Jahrb.* 13 (1891) 287 = *Ziziphus angustifolius* (MIQ.) HATUS. *Nova Guinea Bot. n.* 3 (1960) 13.

Solenostigma angustifolium MIQ. *Sumatra* (1861) 412. — *C. angustifolia* (MIQ.) PLANCH. in DC. *Prod.* 17 (1873) 186, *non* LINDL. *ex WALL. Cat.* (1831) n. 3691, *nomen* = *Ziziphus angustifolius* (MIQ.) HATUS. *Nova Guinea Bot. n.* 3 (1960) 13.

5. APHANANTHE, *nom. gen. cons.*

PLANCH. *Ann. Sc. Nat.* III, 10 (1848) 265, *non* LINK, 1821; MIQ. *Fl. Ind. Bat.* 1, 2 (1859) 218; PLANCH. in DC. *Prod.* 17 (1873) 207; HOOK. *f.* in B. & H. *Gen. Pl.* 3 (1880) 355; ENGL. in E. & P. *Nat. Pfl. Fam.* 3, 1 (1888) 66; BERNARD, *Bull. Herb. Boiss.* II, 6 (1906) 34; GAGNEP. *Fl. Gén. I.-C.* 5 (1927) 690; LEROY, *Bull. Mus. Hist. Nat. Paris* II, 18 (1946) 118, 180; *Fl. Madag. Fam.* 54 (1952) 12; J. Agr. Trop. Bot. Appl. 8 (1961) 72; LI, *Woody Fl. Taiwan* (1963) 105; HUTCH. *Gen. Fl.*

Pl. 2 (1967) 149. — *Homoioceltis* BL. Mus. Bot. 2 (1856) 64. — *Galumpita* BL. l.c. 73; MIQ. Fl. Ind. Bat. 1, 2 (1859) 223. — *Gironniera* subg. *Galumpita* HOOK. f. in B. & H. Gen. Pl. 3 (1880) 356; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1888) 66. — *Mirandaceltis* A. J. SHARP, Bol. Soc. Bot. Mex. 23 (1958) 38, f. 1-4. — **Fig. 24.**

Monoecious, deciduous or semideciduous shrubs or trees, often buttressed. *Innovations* densely or sparsely, whitish-grey to rufous, appressed-pubescent. Indumentum consisting of bulbous-based, unicellular, finely tuberculate hairs and multicellular, glandular hairs. Older branches glabrous, lenticellate, bearing lateral and terminal buds. Stipules lateral, extrapetiolar, subulate, caducous. *Leaves* alternate, petioled, glabrous, coriaceous, triplinerved at base or pinnately nerved. *Inflorescences* ♂, ♀, or very rarely ♂♀, axillary; bracts minute, caducous. — ♂ *Inflorescences* a condensed, multi-flowered raceme, borne on the lower parts of the new shoots; ♂ flowers short-stalked, globular, 4-5-merous; perianth lobes membranous, imbricate in bud, sparsely appressed pubescent outside; stamens glabrous, filaments subulate, inflexed in bud, anthers ovoid-subreniform, non-apiculate, introrse; pistillode absent, replaced by a cluster of whitish to silvery, erect, soft, simple hairs. — ♀ *Flowers* solitary in the axil of the upper leaves of the new shoot, or borne in a 2-3-flowered mixed (♂♀) racemose inflorescence; long-stalked; perianth lobes 4-5, long-persistent; staminode absent; ovary sessile, ovoid-ellipsoid, terete to angular; stigmatic arms tubular; ovule anatropous. *Drupe* fleshy, ovoid-globose, faintly 3-5-angular or ± terete, glabrous; endocarp hard and persistent. *Seed* exalbuminous, coat membranous, few cells thick; embryo curved, hypocotyle ascending, cotyledons more or less equal, involute. Mode of germination unknown.

Distr. About 4-5 spp. Mexico, Madagascar, Ceylon, India, Burma, China (also Hainan), Korea, Japan, Taiwan, Hongkong, Indo-China, Thailand, Andamans, through Malesia to Australia (Queensland and New South Wales) and Solomons. Throughout Malesia (except Malaya and Moluccas): 2 spp. Fig. 25.

Ecol. In Malesia mainly found in areas subject to a rather strong seasonal climate, on various types of soil in the coastal lowlands, hills, and gallery forests, 0-750 m, locally often abundant and forming dense thickets.

In the north temperate and subtropical regions the species flower in April-May and drupes ripen in July-August. Tropical species produce flowers twice a year, viz around March-April and Sept.-Oct. and fruit ripens in June-July or Nov.-Dec.

The deciduous or semideciduous habit, flush-wise mode of growth, structure, size, colour of the inflorescence and flowers suggest that pollination is affected by wind. The drupes which turn to a deep red colour when ripe are possibly dispersed by frugivorous birds.

KEY TO THE SPECIES

1. Leaves ovate, elliptic or obovate, (2-)4-6(-10) by (1-)2-3(-4) cm, triplinerved at base, margin variously serrate or dentate, very rarely subentire; nerves (3-)4-5(-6) pairs, at a 30-45° angle with the midrib. Mature fruit 6-10 by 4-7 mm, beak 1-3 mm. **1. *A. philippinensis***
1. Leaves ovate-elliptic or elliptic-oblong, (5-)10-14(-20) by (2-)3-6 (-8) cm, pinnately nerved, margin entire or very rarely distantly, minute serrulate at the upper half; nerves (5-)7-8(-10) pairs, at an angle of more than 60° with the midrib. Mature fruit 15-20 by 8-12 mm, beak up to 5 mm. **2. *A. cuspidata***

1. *Aphananthe philippinensis* PLANCH. Ann. Sc. Nat. III, 10 (1848) 337; MIQ. Fl. Ind. Bat. 1, 2 (1859) 219; PLANCH. in DC. Prod. 17 (1873) 208; BTH. Fl. Austr. 6 (1873) 160; HOOK. f. Icon. III, 2 (1876) 65, t. 1741; MERR. En. Philip. 2 (1923) 34; FRANCIS, Austr. Rain-forest Trees ed. 2 (1951) f. 24 & 25. — *Taxotrophis rectinervia* F.v.M. Fragm. 6 (1863) 192. — *A. rectinervia* (F.v.M.) PLANCH. in DC. Prod. 17 (1873) 208. — **Fig. 24j-n.**

Shrub to medium-sized tree up to 28 m, 40 cm Ø. Trunk often fluted, low-buttressed, occasionally producing suckers. Bark smooth to finely fissured, peeling off into rectangular flakes, lenticellate. Young parts densely or sparsely greyish-brown or rufous, short, simple pubescent. Stipules subulate, 2-3 by 1/4 mm. *Leaves* glabrous, thin- to thick-coriaceous, ovate, elliptic, or obovate, (2-)3-6(-10) by (1-)2-3(-4) cm, index 2-2.6; base attenuate



Fig. 24. *Aphananthe cuspidata* (BL.) PLANCH. a. Habit, nat. size, b. LS of mature fruit, $\times 1\frac{1}{3}$, c. basal view of fruit, nat. size, d. flowering young shoot, nat. size, e. ♂ flower before anthesis, $\times 6$, f. ditto in section, $\times 9$, g. ♂ flower at anthesis, $\times 13$, h. ♀ flower, $\times 8$, i. ditto in section, $\times 16$. — *A. philippinensis* PLANCH. j. mature fruit, $\times 2$, k. ditto, basal view, $\times 1\frac{2}{3}$, l-n. variation of leaf-form, $\times \frac{2}{3}$ (a-c KOORDERS 21330, d-i KOORDERS 30071, j, k, m, n BORDEN FB 1286, l RAMOS BS 27383).

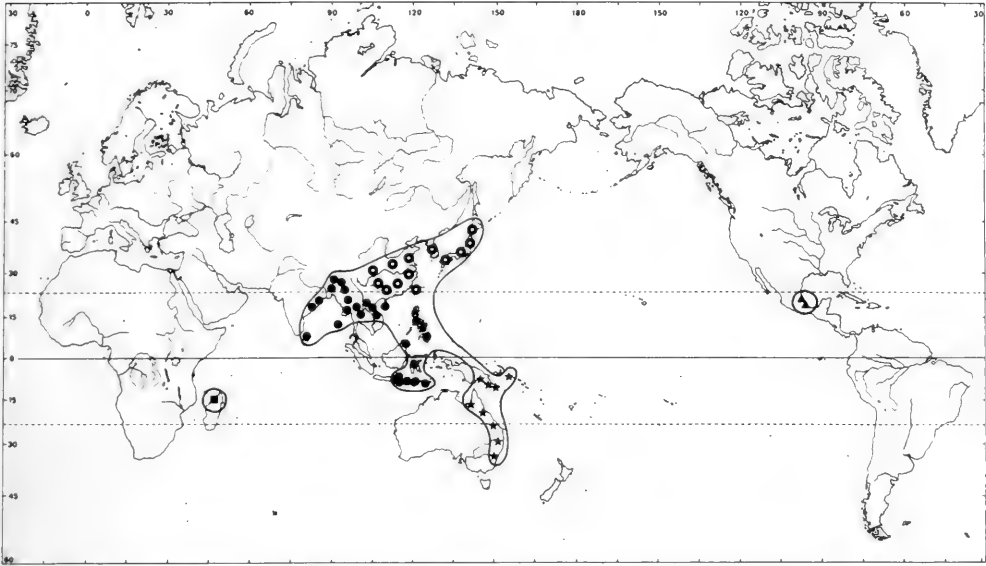


Fig. 25. Range of *Aphananthe* PLANCH. — *A. cuspidata* (BL.) PLANCH. (dots), *A. philippinensis* PLANCH. (stars), *A. sakalava* LEROY (square), *A. aspera* ENGL. (circles), *A. monoica* (HEMSL.) LEROY (triangles).

or rounded, more or less equal-sided; margin serrate, dentate, or rarely subentire, ends of serration occasionally developing into sharply mucronate structures; apex acute, or rounded, tip blunt; midrib and nerves strongly raised beneath, flattish above; nerves (3–)4–5(–7) pairs, ascending, straight or arcuating, subparallel, at 30–45° with the midrib, not anastomosing near the margin; reticulations fine, lax, subscalariform, faintly visible beneath; petiole (2–)3–5(–7) by 1 mm, adaxially flat or shallowly sulcate. — ♂ Inflorescence 1–3 cm Ø, 10–50-flowered; bracts linear-acute or narrow ovate-acute, $\frac{1}{2}$ –1 by $\frac{1}{4}$ mm; ♂ flowers 1–1½ mm Ø; perianth lobes ovate-lanceolate, 1–1½ by $\frac{1}{2}$ –1 mm; filaments $\frac{1}{2}$ –¾ mm, anthers c. $\frac{3}{4}$ by $\frac{1}{2}$ mm. — ♀ Flowers always solitary, ovoid-ellipsoid, 1–1½ by 1 mm, c. 5 mm pedicelled; perianth lobes narrow ovate-acute, $\frac{1}{2}$ –1 by $\frac{1}{2}$ mm; ovary 1–1½ by 1 mm, densely appressed-hairy; stigmatic arms 2–3 mm. Fruit ovoid-globose, 6–8 by 4–6 mm, 3–4-angular, sparsely appressed-pubescent, glabrescent, pedicel c. 5–10 mm.

Distr. Australia (Queensland and New South Wales) and Solomons; in *Malaisia*: New Guinea and Philippines (Luzon). Fig. 25.

Ecol. In primary and secondary forest subject to a rather strong seasonal climate, 0–750 m. In New Guinea it is often found in semi-deciduous gallery- or mixed *Eucalyptus*-forest, occasionally forming dense thickets especially on hillsides. Fl. Apr.–May and Sept.–Oct., fr. mature in July–Aug. and Nov.–Dec.

2. *Aphananthe cuspidata* (BL.) PLANCH. in DC. Prod. 17 (1873) 209. — *Cyclostemon cuspidatum* BL. Bijdr. (1825) 599. — *Galumpita cuspidata* (BL.) BL. Mus. Bot. 2 (1856) 73; Miq. Fl. Ind. Bat. 1, 2

(1859) 224. — *Gironniera nitida* BTH. Fl. Hongk. (1861) 324. — *Gironniera reticulata* THW. En. Pl. Zeyl. 1 (1861) 268; Hook. f. Fl. Br. Ind. 5 (1888) 486. — *Gironniera lucida* KURZ, For. Fl. Burma 2 (1877) 470; Hook. f. Fl. Br. Ind. 5 (1888) 486. — *Gironniera cuspidata* (BL.) KURZ, For. Fl. Burma 2 (1877) 470; J. J. SMITH in K. & V. Bijdr. 12 (1910) 688; MERR. En. Philip. 2 (1923) 35; BACK. & BAKH. f. Fl. Java 2 (1965) 12. — *Gironniera curranii* MERR. Philip. J. Sc. 4 (1909) Bot. 251. — *A. lissophylla* GAGNEP. Bull. Soc. Bot. Fr. 72 (1925) 804; Fl. Gén. I.-C. 5 (1927) 690. — *Gironniera thompsoni* KING ex A. M. & J. M. COWAN, Trees N. Bengal (1929) 122. — ?*Gironniera yunnanensis* HU, Bull. Fan Mem. Inst. Biol. Bot. Ser. 10 (1940) 150. — ?*A. yunnanensis* (HU) GRUDZ. Nov. Syst. Pl. Vasc. USSR (1964) 66. — Fig. 24a–i.

Small to medium-sized tree up to 30 m, 60 cm Ø. Buttresses up to 1 m tall, and 2 m out. Bark surface rough, grey-brown, often flaky. Young branchlets sparsely, minutely, appressed-pubescent, glabrescent; older branchlets sparsely lenticellate. Stipules narrow ovate-acute, 2–3 by 1 mm. Leaves coriaceous, glabrous, ovate-elliptic to elliptic-oblong, (5–)10–14(–20) by (2–)3–6(–8) cm, index 2½–3; base rounded, subcordate, or attenuate, equal-sided or occasionally slightly unequal; margin entire, rarely distantly, minute serrulate in the upper half, often undulate; apex acute, acuminate, or cuspidate, acumen up to 2 cm, sharp-tipped; midrib strongly raised and prominent beneath, impressed to flattish above; nerves (5–)7–8(–10) pairs, slightly raised beneath, flattish above, subparallel, arcuating, at an angle of more than 60° with the midrib, weakly anastomosing near the margin; reticulations fine, indistinct on both surfaces, subscalariform to sub-areolate; petiole glabrous, (5–)8–12(–15) by 1–2 mm, sulcate. — ♂

Inflorescence up to 4 cm, 10–30-flowered; bracts ovate-acute, $1/4$ – $1/2$ by $1/4$ mm; ♂ flower $1\frac{1}{2}$ –2 mm \varnothing , short-stalked; perianth lobes obovate-lanceolate, c. 2 by 1 mm; filaments 1– $1\frac{1}{2}$ mm, anthers ovoid-subreniform, c. 1 mm \varnothing . — ♀ *Flower* solitary or borne in a 2–3-flowered mixed inflorescence, ovoid-ellipsoid, c. 2 by 1 mm; pedicels up to 10 mm; perianth lobes coriaceous, ovate-acute, c. 2 by 1 mm; ovary ovoid, glabrous, c. $1\frac{1}{2}$ by 1 mm; stigmatic arms 2–3 mm. *Fruit* ovoid, glabrous, including the beak 15–20 by 8–12 mm, beak up to 5 mm; pedicel up to 3 cm, 1 mm \varnothing .

Distr. Ceylon, India, Burma, Andaman Is., ? China, Hainan, Hongkong, Indo-China, Thailand; in *Malesia*: NE. Sumatra (Sibolangit, doubtfully native), Java (mainly N. Central & E. parts), Lesser Sunda Islands (Bali, Sumbawa, Flores, Timor, rather common), Borneo (very rare, Kinabalu area), Philippines (Mindanao, rare), Celebes (rare). Fig. 25.

Ecol. In primary lowland to submontane forest, 0–1300 m. In *Malesia* it is mainly confined to low-

land forests subject to a rather pronounced seasonal climate. In Thailand it occurs mainly in the evergreen or semi-deciduous forests along streams. Outside *Malesia* flowering in March–April and fruits mature in July–August. In *Malesia* it flowers twice yearly, viz in Febr.–March and Sept.–Oct., fruits maturing in June–July and Nov.–Dec.

Vern. Java: *suluh*, *wuluh*; Lesser Sunda Is.: *sulu*, Bali, *k. belikat*, Sumbawa, *k. loko*, Flores.

Note. Though I have not been able to examine any of the specimens cited by HU (1940), judging from the description given it is likely that *Gironniera yunnanensis* HU must be referred to this species.

Excluded

Aphananthe negrosensis ELMER, Leaf. Philip. Bot. 2 (1909) 575. — *Calaunia negrosensis* (ELMER) GRUDZ. Nov. Syst. Pl. Vasc. USSR (1964) 54 = *Streblus glaber* (MERR.) CORNER, Gard. Bull. Sing. 19 (1962) 221 (*Moraceae*).

6. GIRONNIERA

GAUDICH. Voy. Bonite (1844) t. 85; PLANCH. Ann. Sc. Nat. III, 10 (1848) 338; BL. Mus. Bot. 2 (1856) 72; MIQ. Fl. Ind. Bat. 1, 2 (1859) 222; PLANCH. in DC. Prod. 17 (1873) 205; HOOK. f. in B. & H. Gen. Pl. 3 (1880) 356; Fl. Br. Ind. 5 (1888) 485; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1888) 66; BERNARD, Bull. Herb. Boiss. II, 6 (1906) 34, map 24; J. J. SMITH in K. & V. Bijdr. 12 (1910) 665; HUTCH. Gen. Fl. Pl. 2 (1967) 149; PHUPHATHANAPHONG, Thai For. Bull. 6 (1972) 49; SOEPADMO in Whitmore, Tree Fl. Mal. 2 (1973) 417. — *Nemostigma* PLANCH. Ann. Sc. Nat. III, 10 (1848) 265, cf. p. 338. — *Helminthospermum* THW. in Hook. J. Bot. Kew Misc. 6 (1854) 301, t. 9c. — **Fig. 26.**

Shrubs or large-sized trees, very rarely buttressed. Bark smooth to finely fissured, grey-brown, often lenticellate. *Innovations* densely or sparsely set with golden yellow or yellowish-brown indumentum consisting of simple bulbous-based, finely tuberculate, appressed or erect hairs and multicellular capitate-glandular hairs. Stipules extrapetiolar, free but overlapping each other and completely enclosing the bud, on falling leaving a circular scar around the node. *Leaves* pinnately nerved, nerves parallel, regularly well-spaced. *Inflorescence* ♂ or ♀, very rarely ♂♀, axillary or borne on older, leafless branchlets, 1-many-flowered, paniculate, racemose, thyrsoid, or capitate; bracts ovate-acute, minute, caducous, but rather long persistent in the ♀ inflorescence. — ♂ *Flower* globular, sessile or short-stalked along the axes; perianth lobes 5, imbricate in bud; stamens glabrous, anthers introrse; filament subulate, inflexed; anthers ovoid-reniform, apiculate, sub-basifixed; pistillode present, rather well-developed or very rudimentary, densely set with whitish or silky erect hairs. — ♀ *Flower* ovoid-ellipsoid, compressed; perianth lobes 4–5, usually unequal in size, long persistent; staminodes absent; ovary ovoid-ellipsoid, strongly compressed, sessile, densely or sparsely appressed-hairy, glabrescent; stigmatic arms up to $1\frac{1}{2}$ cm long, curled in bud, later spreading, rather long persistent; ovule anatropous. *Drupe* ovoid-globose, convex elliptic lens-shaped; exocarp thin, strongly adnate to the hard and persistent endocarp. *Seed*

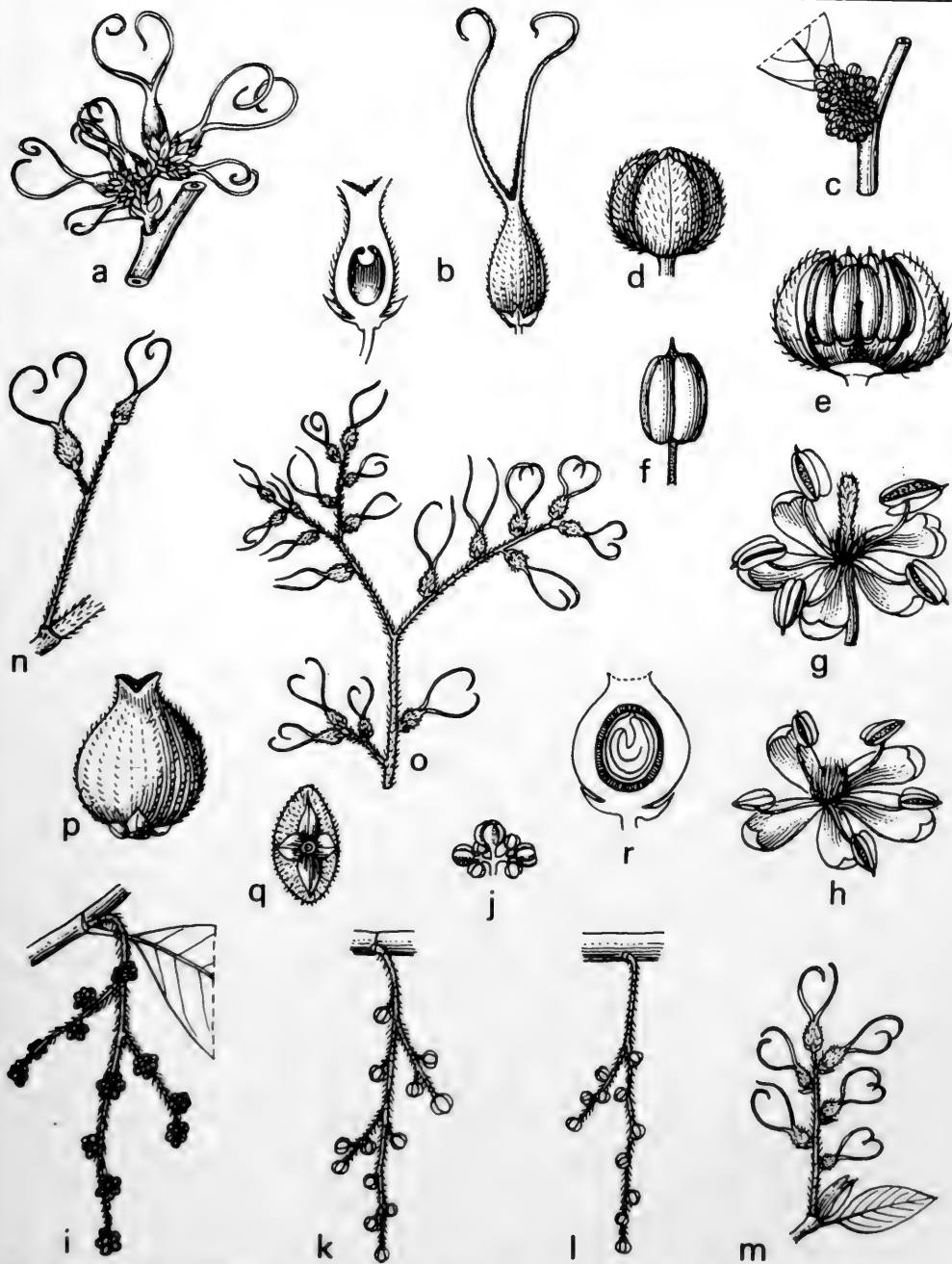


Fig. 26. *Gironniera celtidifolia* GAUDICH. a-b. ♀ Flowers, one in CS, c-g. ♂ flowers, various details. — *G. subaequalis* PLANCH. h. ♂ Flower, m. young infructescence, p-r. fruits, one in LS. — *G. nervosa* PLANCH. i-j. ♂ Flowers. — *G. parvifolia* PLANCH. k. ♂ Inflorescence, n. young infructescence. — *G. rhamnifolia* BL. l. ♂ Inflorescence. — *G. hirta* RIDL. o. ♂ Young infructescence. a, c, m-r $\times \frac{2}{3}$, b $\times 3$, d-e, g-h $\times 7$, f $\times 9$, i $\times \frac{2}{3}$, j $\times 2$, k-l $\times \frac{1}{3}$, (a-b BS 48861, c-g MALIWANAG 119, h RAHMAT SI BOEEA 9311, i-j KEP/FRI 14582, k KEP/FRI 18017, l ZIPPELIUS s.n., m MOH. SHAH 519, n SF 34908, o bb 30873, p-r KEP/FRI 99766).

coat membranous, a few cells thick; endosperm absent; embryo curved, hypocotyle ascending; cotyledons fleshy, narrow, equal. Mode of germination unknown.

Distr. 6 spp., SE. Asia: Ceylon, Andaman Is., Burma, Thailand, Indo-China, China (Yunnan, Kwangtung, Canton, Hainan, Hongkong), Micronesia (Palau and Ponape Is.), Melanesia (Solomons), Polynesia (Samoa, Fiji); in *Malesia*: throughout the region except for the eastern part of Java, the Lesser Sunda Islands, and the SE. Moluccas. Fig. 27.

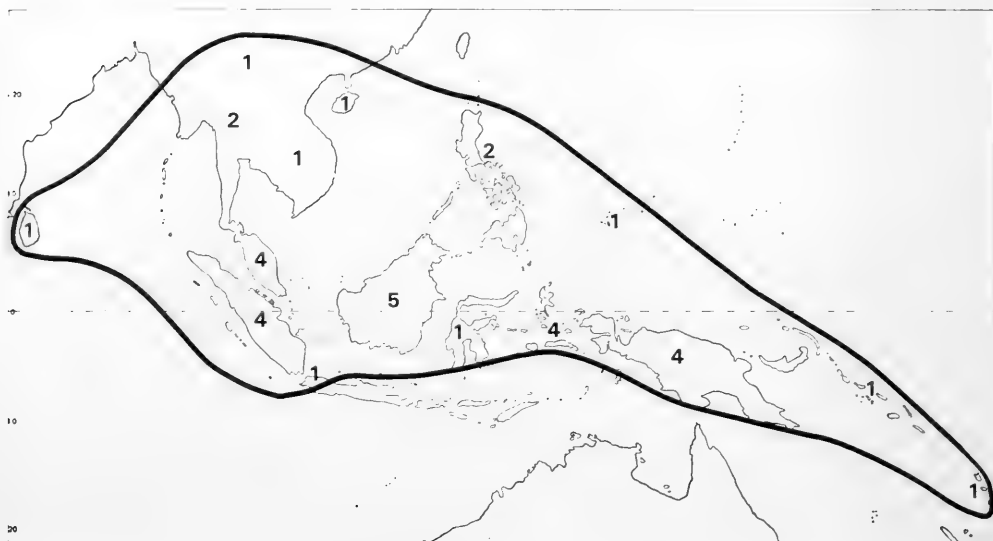


Fig. 27. Approximate range of the genus *Gironniera* GAUDICH. with the number of species in each island or partial area. There are no endemic species.

Fossils. WOLFE (in Graham, *Flor. & Paleoflor. Asia & N.E. America*, 1972, 200, pl. IV, f. 2) reported leaf-impressions attributed to *Gironniera* from the Early Ravenian Flora of Alaska (Middle Eocene). However, in examining the published photograph (p. 211), I am very much in doubt whether the specimen belongs to the genus at all.

Ecol. Understorey shrubs or trees in both primary and secondary forests, at 0–1300 m, often abundant and gregarious; on various types of soil, including those derived from limestone. In areas where the seasonal climate is prominent mainly found in the evergreen forest along streams.

Judging from the structure of the flower and inflorescence, it is inferred that the pollination may be affected by wind. The drupes which turn to bright yellow or orange in colour when ripe are mostly barren, and they may be dispersed by various species of frugivorous birds. Direct observations in the field are, however, wanting.

Notes. *Gironniera* spp. have a continuous, flush-wise growth habit and have the ability to produce flowers and fruits at a very young (sapling) stage (2–3 m tall). Since the plants are often very common locally both in the primary and secondary forests, produce flowers and fruits regularly, and are very easy to collect, most of the examined specimens were gathered from these young plants. The presence of so many specimens collected from juvenile plants hampers proper identification even when they are fertile.

In the present revision, the characters used in the key were taken from specimens collected from mature or fully grown trees, while those mentioned in the description of each species include also data from specimens collected from the young plants, thus to include the total morphological variability.

On the material and field notes so far available it is impossible at this stage to determine whether the genus is strictly monoecious or dioecious. In most cases, the specimens display only fruits or ♂ inflorescences, thus giving the impression that the genus is dioecious. However, there are a few collections (in all species but *G. hirta*) which have both ♂ inflorescences and infructescences attached to the same branchlet, or they are borne on separate branchlets belonging to a single collecting number.

Mrs. PHUPHATHANAPHONG l.c. accommodated the Malesian specimens into two species, *G. nervosa* and *G. celtidifolia*, without argumentation. I cannot agree with this view.

KEY TO THE SPECIES

(Based on specimens from mature trees)

1. ♂ & ♀ Inflorescence and infructescence a condensed, capitate thyrses or panicle, axillary or borne on older leafless branchlets. ♂ Flower with a rather well-developed pistillode. Leaves thick-leathery, distantly serrate or subentire. Terminal bud (stipules) up to $4\frac{1}{2}$ by $\frac{1}{2}$ cm **1. *G. celtidifolia***
1. ♂ & ♀ Inflorescence and infructescence a lax, branched or unbranched panicle, raceme, or thyrses, always axillary. ♂ Flower with a strongly rudimentary pistillode. Leaves chartaceous to thick leathery, in Mal. specimens mostly entire. Terminal bud less than 3 cm by less than 0.3 cm.
2. Mature leaf densely pubescent beneath. ♂ Inflorescence a much-branched thyrses; ♂ flowers arranged in condensed cymoid clusters of 5–10 along the axes.
3. Young branchlets densely short appressed-hairy. Leaves elliptic-lanceolate to elliptic-oblong, index $2\frac{1}{2}$ –3, broadest at the middle; nerves (12–)15(–17) pairs, parallel, straight, 5–8 mm spaced, not or only weakly anastomosing along the margin. Well-developed ♀ inflorescence (thus also the infructescence) mostly an unbranched panicle, c. 3 cm long, bearing less than 10 flowers (fruits).
2. ***G. nervosa***
3. Young branchlets densely set with long, erect hairs. Leaves mostly ovate-elliptic, rarely elliptic-oblong, index c. 2, broadest below or rarely at the middle; nerves (8–)10–12(–14) pairs, subparallel, 10–15 mm spaced, arcuating and anastomosing towards the margin. Well-developed ♀ inflorescence (cq. infructescence) a mostly much-branched panicle 5–10 cm long, bearing up to 20 fruits
3. ***G. hirta***
2. Mature leaf glabrous. ♂ Inflorescence unbranched or a branched raceme or panicle; ♂ flowers solitary along the axes.
4. Mature leaf thick-coriaceous, broad-ovate, elliptic, or elliptic-oblong, broadest below or at the middle, index 2– $2\frac{1}{2}$, base unequal-sided. Terminal bud 2–3 by 0.2–0.4 cm. Well-developed ♂ inflorescence a much-branched panicle, carrying 40–100 flowers. Well-developed ♀ inflorescence (cq. infructescence) carrying (2–)5–10(–15) flowers (fruits). Mature fruits 10–12 by 9 by 5 mm.
4. ***G. subaequalis***
4. Mature leaf chartaceous to thin-coriaceous, elliptic-lanceolate or elliptic-obovate, broadest at or slightly above the middle, index ($2\frac{1}{2}$ –)3(– $3\frac{1}{2}$), base more or less equal-sided. Terminal bud 2 by $\frac{1}{2}$ cm. Well-developed ♂ inflorescence an unbranched panicle carrying 15–30 flowers. Well-developed ♀ inflorescence (cq. infructescence) carrying 1–3(–5) flowers (fruits). Mature fruits 7–8 by 5–6 by 3–4 mm.
5. Nerves (5–)6–8(–9) pairs. ♂ Flowers short-stalked. Axes of ♀ inflorescence (infructescence) slender and thin (less than 0.3 mm), 4–10 cm long, carrying 1–3(–5) flowers (fruits). **5. *G. parvifolia***
5. Nerves 10–12 pairs. ♂ Flowers sessile along the axes. Axes of ♀ inflorescence (infructescence) $\frac{1}{2}$ –1 mm thick, 3–4 cm long, carrying (1–)3–5 flowers (fruits). **6. *G. rhamnifolia***

1. *Gironniera celtidifolia* GAUDICH. Voy. Bonite (1844) t. 85; PLANCH. Ann. Sc. Nat. III, 10 (1848) 340; MIQ. Fl. Ind. Bat. 1, 2 (1859) 223; SEEM. Fl. Vit. (1865) 236; PLANCH. in DC. Prod. 17 (1873) 207; LAUT. Bot. Jahrb. 50 (1913) 326; MERR. En. Philip. 2 (1923) 35; PARHAM, Pl. Fiji Is. (1964) 88. — *G. sibuyanensis* ELMER, Leaflet. Philip. Bot. 5 (1913) 1845; MERR. En. Philip. 2 (1923) 35. — *G. grandifolia* MERR. & PERRY, J. Arn. Arb. 20 (1939) 325. — *G. retinervia* MERR. & PERRY, l.c. 326. — Fig. 26a–g.

Shrub or medium-sized tree up to 18 m tall and 25 cm Ø. Bark greyish-brown to dark-brown, smooth or finely fissured. Terminal buds c. $4\frac{1}{2}$ by $\frac{1}{2}$ cm; stipules narrow lanceolate-acute, c. $4\frac{1}{2}$ by $\frac{1}{4}$ – $\frac{1}{2}$ cm. Leaves thick-coriaceous, elliptic-, lanceolate-, or obovate-oblong, (8–)15–25(–42) by (4–)6–12(–19) cm, index $2\frac{1}{2}$ – $3\frac{1}{2}$, broadest at or above the middle; base unequal-sided, attenuate, rounded, or cordate-auculate; margin distantly serrate at least for the upper half or subentire; apex rounded, acute, or acuminate-caudate, acumens up to 4 cm long; glabrous above, sparsely appressed-hairy beneath especially on midrib and nerves, glabrescent; midrib and nerves strongly raised beneath, flattish to shallowly impressed above; nerves (8–)12–16(–19) pairs, anastomosing along the margin; reticulations subscalariform, evenly spaced, distinct beneath; petiole (3–)5–12(–15) by (1–) $1\frac{1}{2}$ – $2\frac{1}{2}$ (–4) mm,

terete or adaxially flat near the base, strigose, glabrescent. Inflorescences a condensed, capitate, much-branched panicle or thyrses, axillary or borne on older, leafless branchlets, many-flowered, ♂ or ♀, very rarely ♂♀, including the bracts densely appressed-hairy; bracts 2–4 by 2 mm. — ♂ Flower c. $1\frac{1}{2}$ –2 mm Ø, sessile or short-stalked along the axes, perianth lobes ovate-elliptic, concave, c. $1\frac{1}{2}$ –2 by 1– $1\frac{1}{2}$ mm; filaments $1\frac{1}{2}$ –2 mm, anthers 1– $1\frac{1}{2}$ by 1 mm; pistillode cylindrical, $1\frac{1}{2}$ –2 by $\frac{1}{2}$ mm, at base surrounded by dense, whitish, erect hairs. — ♀ Flower 2–3 by 2 mm; perianth lobes ovate, 1– $1\frac{1}{2}$ by $\frac{1}{2}$ –1 mm; ovary 2–3 by $1\frac{1}{2}$ –2 mm, densely appressed-hairy; stigmatic arms 1– $1\frac{1}{2}$ cm, slender. Fruit ovoid-ellipsoid, sparsely appressed-hairy, glabrescent, 5–8 by 4–6 by 3–4 mm, beak up to 5 mm.

Distr. Micronesia (Palau, Ponape), Melanesia (Solomons), Polynesia (Samoa, Fiji); in *Malesia*: Borneo (doubtful record), Philippines (common and widespread), Moluccas (Morotai, Halmahera), New Guinea (common in W. & E.; also in Admiralty, Misima, Sudest, and Rossel Is.).

Ecol. In both primary and secondary forests, 0–1200 m; often locally abundant as understorey shrub or tree. Fl. fr. Jan.–Dec.

Vern. Philippines: *ablang*, Mang., *dita*, Tag., *mangabau*, Bis., *tanguntungan*, Mbo.; Moluccas: *koko*, Morotai; New Guinea: *aimarwirieh*, Biak, *taun*, Wapil lang., Sepik Distr.; Solomons:

aisulia, Kwara; Fiji: *masivau*, *sisisi*; Samoa: *pua-pua*, *puluvao*.

Notes. In most specimens examined, the ♂ inflorescence shows abnormal development and produces a malformed structure consisting of numerous superimposed bracts in the axils of which are found sterile structures resembling in size and shape that of the pistillode in the normally developed and functionally ♂ flowers. Well-developed and functionally ♂ flowers are to be found only at the distal parts of these abnormally developed inflorescences. In a ♂♀ inflorescence, which is very rarely present, the functionally ♀ flowers are borne on the central main axis and they are flanked by two or more lateral, functionally ♂ flowers. Most of the fruits so far examined (more than 95%) are barren.

Size and shape of the leaf are rather variable. In general, specimens collected from a higher altitude or from a more exposed habitat have a smaller leaf and less pairs of nerves than those gathered from lowland and shady localities. Intermediates are, however, not uncommon, and for this reason *G. sibuyanensis*, *G. grandifolia*, and *G. retinervia* are here reduced.

2. *Gironniera nervosa* PLANCH. Ann. Sc. Nat. III, 10 (1848) 338; BL. Mus. Bot. 2 (1856) 74; MIQ. Fl. Ind. Bat. 1, 2 (1859) 222; PLANCH. in DC. Prod. 17 (1873) 206; KURZ, For. Fl. Burma 2 (1877) 469; HOOK. f. Fl. Br. Ind. 5 (1888) 485; MERR. En. Born. (1921) 216; RIDL. Fl. Mal. Pen. 3 (1924) 320; CORNER, Ways. Trees (1940) 688; SOEPADMO in Whitmore, Tree Fl. Mal. 2 (1973) 419, f. 2. — *G. penangiana* GANDOG. Bull. Soc. Bot. Fr. 66 (1919) 289. — *G. sponioides* GANDOG. l.c. 289. — Fig. 26i-j.

Small to large-sized tree up to 40 m, 60 cm Ø. Buttresses sometimes present, low. Bark smooth or finely fissured, grey-green to dark grey-brown, often hoop-marked and lenticellate. Terminal bud 1-2 by $\frac{1}{4}$ - $\frac{1}{2}$ cm; stipules $\frac{1}{2}$ -2 by $\frac{1}{4}$ - $\frac{1}{2}$ cm. Leaves thick-coriceous, rigid, elliptic-lanceolate to elliptic-oblong, (6 $\frac{1}{2}$ -)10-15(-18) by (2 $\frac{1}{2}$ -)4-6 (-8) cm, broadest at the middle, index 2 $\frac{1}{2}$ -3; except for the midrib and lateral nerves glabrous above, densely set with yellowish-brown, soft, slender hairs beneath; base rounded or attenuate, unequal-sided; margin entire, often recurved; apex rounded to acute; midrib and nerves strongly raised beneath, flattish or impressed above; nerves (12-14-16(-17) pairs, 5-8 mm spaced, arcuating but not anastomosing near the margin, forming an angle of up to 60° with the midrib; reticulations dense, regularly spaced, scalariform or subscalariform, strongly raised and prominent beneath, obscure to faintly visible above; petiole 5-10 by 1-2 mm, subterete, densely yellowish-brown appressed, pubescent. Inflorescences ♂ or ♀, axillary, borne on separate shoots, including the bracts densely yellowish-brown, appressed-pubescent; bracts narrow ovate-acute, c. 1-2 by 1 mm. — ♂ Inflorescence a slender, lax, pendent, branched panicle of condensed cymes, up to 7 cm long, bearing 20-100 flowers; ♂ flowers in clusters of 5-10 along the axes, c. 2 by 2 mm; perianth lobes broad ovate-acute, c. 1-1 $\frac{1}{2}$ by 1 mm, densely, short appressed-hairy outside; filaments 1-1 $\frac{1}{2}$ mm, anthers ovoid, c. 1 mm Ø; pistillode strongly

rudimentary. — ♀ Inflorescence a simple or branched panicle, up to 2 $\frac{1}{2}$ cm long, 5-10-flowered; ♀ flowers sessile along the axes, compressed ovoid-conical, 2-3 by $\frac{1}{2}$ -2 mm; perianth lobes ovate-acute, densely appressed-hairy outside, $\frac{1}{2}$ -2 by 1 mm; ovary densely appressed-hairy, $\frac{1}{2}$ -3 by 1-1 $\frac{1}{2}$ mm; stigmatic arms 5-10 mm. Infructescence up to 3 cm long, bearing (2-4-6(-8) fruits. Fruit subglobose or ovoid, densely appressed-pubescent, 5-8 by 4-6 by 3-4 mm, short-beaked.

Distr. Thailand; in *Malesia*: Malay Peninsula (incl. Singapore; common), Sumatra (rather rare), Borneo (common).

Ecol. In primary and secondary forests, 0-1300 m, mostly below 500 m; often common locally as understorey tree in lowland forests. In Thailand it occurs mainly in the evergreen forest along streams. Fl. fr. Jan.-Dec., but mainly during July-Dec.

Vern. Malaya: *médang berbulu*, *m. kasap*, *tapis*, M; N. Borneo: *luazon*, Kadasan, *hugot-hugot*, Dusun; Kalimantan: *kayu ruas*, Bandjar, *gagas*, Bassap.

3. *Gironniera hirta* RIDL. J. Str. Br. R. As. Soc. n. 82 (1920) 194; Fl. Mal. Pen. 3 (1924) 321; SOEPADMO in Whitmore, Tree Fl. Mal. 2 (1973) 417, f. 2. — Fig. 26o.

Shrub to medium-sized tree up to 30 m, 30 cm Ø. Bark smooth, light to grey-brown. Young branchlets, petiole, stipules, terminal bud densely set with golden yellow, long, soft, erect hairs. Terminal buds ovoid-conical, $\frac{1}{2}$ -3 by $\frac{1}{4}$ - $\frac{1}{2}$ cm; stipules $\frac{1}{2}$ -3 by $\frac{1}{2}$ cm. Leaves thick-coriceous, rigid, ovate-elliptic or rarely elliptic-oblong, (6-14-18 (-23) by (3-5-8(-12) cm, index c. 2; base rounded, subcordate or attenuate, unequal-sided; margin entire, rarely distantly serrulate in the upper half; apex rounded, acute to acuminate; except for the midrib and nerves which are densely or sparsely set with long, appressed or erect, soft hairs, glabrous above, densely soft-pubescent beneath; midrib and nerves raised and distinct beneath, flattish or impressed above; nerves (8-10-12(-14) pairs, 10-15 mm spaced, arcuating towards and anastomosing near the margin; reticulation subscalariform to subareolate, well-spaced, distinct beneath, obscure above; petiole 2-10 by 1-3 mm, terete or flat above near the base. Inflorescences ♂ or ♀, axillary, borne on separate branches, including the bracts densely golden yellow pubescent; bracts ovate-acute, 1-1 $\frac{1}{2}$ by $\frac{1}{2}$ -1 mm. — ♂ Inflorescence slender, lax, branched, thyrsoid, up to 8 cm long, bearing up to 100 flowers; ♂ flower $\frac{1}{2}$ -2 mm Ø, sessile along the axes, in cymoid clusters of 3-10; perianth lobes $\frac{1}{2}$ -2 by 1 mm, densely appressed-hairy outside; filaments 1-1 $\frac{1}{2}$ mm, anthers ovoid-reniform, c. 1 mm Ø; pistillode strongly rudimentary. — ♀ Inflorescence (as seen in a very young infructescence) a branched panicle, up to 5 cm, carrying 2-20, sessile or short-stalked flowers; perianth lobes narrow ovate-acute, c. 2 by 1 mm, densely appressed short-hairy outside; ovary (young fruit) ovoid, densely short-, appressed-hairy, c. 3 by 2 mm; stigmatic arms up to 1 cm. Infructescence up to 10 cm long, axes c. 1 mm thick, bearing (2-5-15(-20) fruits. Drupe ovoid-compressed, densely short-appressed-pubescent, 8-10 by 6-8 by 3-5 mm, short-beaked.

Distr. *Malesia*: Malaya (rather rare), Sumatra (rare), Borneo (common), Moluccas (rare), New Guinea (rare, mainly in W.).

Ecol. Scattered as an understorey shrub or tree in lowland forests, 0–700 m. *Fl. fr.* Jan.–Dec.

Vern. Malaya & Sumatra: *hampas tēbu*, *hampēlas burung*, *mēdang berbulu*, *m. kasap*, M; Kalimantan: *kayu ruas*, *lēmprung bulu*, Banjar; Sarawak: *puloh*, Iban; New Guinea: *warpis*, Biak.

Note. Closely related to *G. nervosa*, but readily distinguished from the latter by the characters mentioned in the key. Specimens from Malaya (mainly from the Kluang area in Johore and Pahang), including the type, have much thinner leaves with a distantly serrulate margin than those from Sumatra, Borneo, and New Guinea. Since in most cases the field notes of the Malayan specimens indicate that the height of the tree was never more than 3 m, it is assumed that these specimens have been collected from saplings.

4. *Gironniera subaequalis* PLANCH. Ann. Sc. Nat. III, 10 (1848) 339, *p.p.*, excl. *var. ceylanica*; BL. Mus. Bot. 2 (1856) 73, incl. *var. brevistylis* BL., *var. scabrida* BL. et *var. serrulata* BL. l.c. 74; MIQ. Fl. Ind. Bat. 1, 2 (1859) 222; PLANCH. in DC. Prod. 17 (1873) 206; HOOK. f. Fl. Br. Ind. 5 (1888) 485; HEMSL. J. Linn. Soc. Bot. 26 (1894) 452; BRANDIS, Ind. Trees (1906) 596; J. J. SMITH in K. & V. Bijdr. 12 (1910) 666; Nova Guinea 8 (1912) 892, incl. *var. papuana* J. J. S.; LAUT. Bot. Jahrb. 50 (1913) 326; MERR. En. Born. (1921) 217; En. Philip. 2 (1923) 35; RIDL. Fl. Mal. Pen. 3 (1924) 320; GAGNEP. Fl. Gén. I.-C. 5 (1927) 678; CORNER, Ways. Trees (1940) 690; BACK. & BAKH. f. Fl. Java 2 (1965) 12; SOEPADMO in Whitmore, Tree Fl. Mal. 2 (1973) 419, f. 2. — *Sponia annulata* TEYSM. & BINN. Ned. Kruidk. Arch. 3 (1855) 408. — *G. costata* MIQ. in Zoll. Syst. Verz. (1855) 88; Fl. Ind. Bat. 1, 2 (1859) 223. — *G. chinensis* BTH. Fl. Hongk. (1861) 324. — *G. nervosa* var. *subaequalis* (PLANCH.) KURZ, For. Fl. Burma 2 (1877) 470. — *G. amboinensis* LAUT. Bot. Jahrb. 50 (1913) 326. — *G. longifolia* CRAIB, Kew Bull. (1918) 371. — *G. sumatrana* GANDOG. Bull. Soc. Bot. Fr. 66 (1919) 288. — *G. blumei* GANDOG. l.c. 288. — *G. borneensis* GANDOG. l.c. 288. — *G. ferruginea* GANDOG. l.c. 289. — Fig. 26h, m, p-r.

Small to large-sized tree up to 40 m, 60 cm Ø. Bark smooth to finely fissured, pustular or lenticellate. Terminal bud 2–3 by $\frac{1}{4}$ – $\frac{1}{2}$ cm; stipules linear-lanceolate, $\frac{1}{2}$ – $2\frac{1}{2}$ by $\frac{1}{4}$ – $\frac{1}{2}$ cm. Leaves thick-coriaceous, broad ovate-elliptic or elliptic-oblong, (6–)12–16(–21) by (3 $\frac{1}{2}$ –)5–8(–13) cm, index 2–2 $\frac{1}{2}$, except for midrib and nerves glabrous; base attenuate or rounded, unequal-sided; margin entire or occasionally, especially when young, distantly serrulate at least for the upper half; apex rounded or attenuate-acute; midrib and nerves raised beneath, flattish above, sparsely or densely yellowish-brown appressed short-hairy beneath; nerves (6–)8(–10) pairs, 10–15 mm spaced, at more than 60° with the midrib, arcuating and anastomosing along the margin; reticulations subscalariform, fine, dense or rather well-spaced, slightly and clearly visible beneath, flattish and faintly visible above or obscure; petiole 5–15 by 1–2 mm, terete or adaxially flat near the base, sparsely or densely appressed, simple, short, yellowish-brown

pubescent, glabrescent. *Inflorescence* ♂ or ♀, axillary, borne on separate branchlets or rarely on the same branchlet, including the bracts sparsely to densely short, yellowish-brown, appressed-hairy, glabrescent; bracts ovate-acute, 1–2 by $\frac{1}{2}$ –1 mm. — ♂ *Inflorescence* paniculate, pendent, much-branched, 40–100-flowered, axes up to 3–7 cm long, $\frac{1}{2}$ –1 mm thick; ♂ flowers $1\frac{1}{2}$ –2 $\frac{1}{2}$ mm Ø, sessile and solitary along the axes or in clusters of 3–5 on short, condensed secondary branches of the panicle; perianth lobes sparsely short appressed-pubescent, glabrescent, broadly ovate-rounded, 2–2 $\frac{1}{2}$ by $\frac{1}{2}$ –2 mm; filaments $1\frac{1}{2}$ –2 mm, anthers ovoid-subreniform, c. 1 by 1 mm; pistillode strongly rudimentary. — ♀ *Inflorescence* racemose, unbranched or more commonly branched, axes 3–6 cm long, 1–1 $\frac{1}{2}$ mm thick, bearing (2–)5–10 (–15) flowers; ♀ flowers solitary and short-stalked along the axes, 2–4 by 2 mm; perianth lobes broadly ovate-acute, $1\frac{1}{2}$ –2 by $\frac{1}{2}$ mm, sparsely appressed-pubescent outside; ovary 2–3 by 2 mm, densely appressed-pubescent, glabrescent; stigmatic arms up to 2 cm. *Infructescence* with a sturdy axis up to 2 mm thick, 5–10 cm long, bearing (2–)5–8 (–10) fruits. *Fruit* 1–1 $\frac{1}{4}$ by 8–9 by 5–6 mm, sparsely appressed-pubescent, glabrescent, beak 2–5 mm.

Distr. A rather variable species widely distributed in the Andaman Is., Burma, China (Yunnan, Kwangtung, Canton, Hainan), Hongkong, Indo-China, Thailand, throughout *Malesia* (except the Lesser Sunda Is.).

Ecol. Understorey shrub or tree in primary and secondary forest, 0–1300 m, more commonly in the lowland between 200–500 m. *Fl. fr.* Jan.–Dec.

Vern. Malaya: *hampas tēbu*, *mēdang kasap*, M; Sumatra: *silu*, *siluk*, M; W. Java: *ki bulu*, S; N. Borneo: *kuayun*, *ruwayon*, Dusun, *untoh bulu*, Iban; Kalimantan: *katul*, Bulungan; Anambas Is.: *pupoh*, M; W. New Guinea: *gawa*, *gēwa*, *mēgawa*, Mooi, *nadjun*, *nitjun*, Kebar, *bobohufeka*, Manikiong, *warpis*, Biak.

5. *Gironniera parvifolia* PLANCH. Ann. Sc. Nat. III, 10 (1848) 338 ('*parvifolium*'); MIQ. Fl. Ind. Bat. 1, 2 (1859) 223; PLANCH. in DC. Prod. 17 (1873) 206; HOOK. f. Fl. Br. Ind. 5 (1888) 486; RIDL. Fl. Mal. Pen. 3 (1924) 321; CORNER, Ways. Trees (1940) 689; SOEPADMO in Whitmore, Tree Fl. Mal. 2 (1973) 419, f. 2. — *G. subaequalis* var. *ceylanica* PLANCH. Ann. Sc. Nat. III, 10 (1848) 339; THW. En. Pl. Zeyl. (1861) 268; HOOK. f. Fl. Br. Ind. 5 (1888) 485. — *Helminthospermum scabridum* THW. in Hook. J. Bot. Kew Misc. 6 (1854) 303, t. 9c. — *G. paucinervia* MERR. J. Str. Br. R. As. Soc. n. 77 (1917) 189; En. Born. (1921) 217. — *G. zeylanica* GANDOG. Bull. Soc. Bot. Fr. 66 (1919) 288. — *G. scabrida* (THW.) ALSTON in Trimen, Fl. Ceyl. 6 (1931) 267. — Fig. 26k, n.

Shrub or small-sized tree up to 15 m, 20 cm Ø. Bark smooth to finely fissured, lenticellate, grey-green or grey-brown. Terminal bud (5–)8–15(–18) by 1–3 mm; stipules linear-acute, 8–15 by 2–3 mm. Leaves chartaceous to thin-coriaceous, rarely coriaceous, elliptic-lanceolate or elliptic-obovate, very rarely ovate-elliptic, (4–)8–12(–16) by (1 $\frac{1}{2}$ –)3–4(–5) cm, index 3–3 $\frac{1}{2}$, glabrous; base attenuate or rounded, more or less equal-sided; margin entire or sometimes minutely and distantly serrulate

in the upper half (extra-Mal. and young specimens); apex attenuate-acute or rounded-acuminate; midrib and nerves slightly raised beneath, flattish above; nerves (5)–6–8(–9) pairs, 7–10 mm spaced, at up to 60° with the midrib, arcuating and anastomosing along the margin; reticulations subareolate, fine, dense, visible beneath, obscure above; petiole 5–7 by 1–1½ mm, sulcate. *Inflorescences* ♂ or ♀, axillary, borne on separate branchlets, including the bracts sparsely, short, appressed-pubescent, glabrescent; bracts ovate-acute, membranous, c. 1 by ½ mm. — ♂ *Inflorescence* a slender, pendulous, simple or branched raceme, bearing 15–30 flowers, axes up to 5 cm long, 0.2–0.3 mm thick; ♂ flowers solitary along the axes, short-stalked, 1½–2 mm Ø; perianth lobes broad ovate, c. 1½–2 by 1–1½ mm; filaments 1–1½ mm long, anthers ovoid-reniform, ¾–1 mm Ø; pistillode strongly rudimentary. — ♀ *Inflorescence* a slender, 1–3(–5)-flowered raceme, 4–10 cm long, axes 0.2–0.3 mm thick; ♀ flower 2–3 by 2 mm, short-stalked; perianth lobes mostly 4, unequal in size, 1½–2½ by 1–2 mm; ovary sparsely short appressed-pubescent, 2–3 by 2 mm; stigmatic arms up to 1½ mm. *Infructescences* slender, up to 10 cm long, bearing 1–3(–5) fruits, axes thinner than 1 mm. *Fruit* c. 8 by 6 by 4 mm, sparsely, short appressed-pubescent, glabrescent; beak up to 5 mm.

Distr. Ceylon; in *Malesia*: Malay Peninsula (incl. Singapore; very common), Sumatra (rare), Borneo (common).

Ecol. In primary as well as in secondary forest, 0–1300 m, but mostly in the lowland, on various types of soil including those derived from limestone. *Fl.* Jan.–April, *fr.* Oct.–Dec.

Vern. Malaya: *hampas tēbu*, *mēdang kasap*, M; Sarawak: *tēpadē*, Kelabit.

Note. As in other species of the genus, most of the specimens so far available suggest that the plant is monoecious. However, in MAINGAY K.D. 1470 from Malaya both the ♂ inflorescence and infructescence are found on separate branchlets of the same collection number. Assuming that these branchlets were collected from the same tree, it would suggest that the species is monoecious but producing ♂ and ♀ flowers at different stages of its growth. More field work is required to determine its breeding system.

6. *Gironniera rhamnifolia* BL. Mus. Bot. 2 (1856) 74, t. 25; MIQ. Fl. Ind. Bat. 1, 2 (1859) 223; PLANCH. in DC. Prod. 17 (1873) 206; LAUT. Bot. Jahrb. 50 (1913) 326. — Fig. 261.

Shrub to medium-sized tree, up to 25 m, 40 cm Ø. Bark smooth, pale grey-brown. Branchlets initially densely set with simple, yellowish-brown, soft, erect hairs, glabrescent. Terminal buds 1–1½ by 0.2–0.3 cm; stipules narrow elliptic-lanceolate, c. 1½ by ¼ cm. *Leaves* chartaceous to thin-coriaceous, glabrous, elliptic-lanceolate or rarely ovate-elliptic, (5)–8–15(–17) by (2)–4–6(–8) cm, index 2½–3½; base rounded or attenuate, ± equal-sided; margin entire; apex acute to acuminate; midrib and nerves slightly raised beneath, flattish to slightly impressed above, often densely, short, appressed-hairy; nerves 10–13 pairs, at an angle of over 60° with the midrib, arcuating and anastomosing towards the margin; reticulations fine, lax, subscalariform to subareolate, faintly visible beneath; petiole 5–10 by 1–1½ mm, glabrous, shallowly furrowed or flat above near the base. *Inflorescences* ♂ or ♀, axillary, including the bracts sparsely short, yellowish-brown appressed-pubescent; bracts narrow ovate-acute, c. 1 by ½ mm. — ♂ *Inflorescence* an unbranched or branched panicle, 3–5 cm long, bearing 15–30 flowers; ♂ flowers sessile and solitary along the axes, c. 1–1½ mm Ø; perianth lobes ovate, 1½–2 by 1 mm, sparsely short, appressed-pubescent outside; filaments 1½–2 mm, anthers ovoid-reniform, ½–1 mm Ø; pistillode strongly rudimentary. — ♀ *Inflorescence* an unbranched, (1)–3–5-flowered panicle, 3–4 cm long with the axes c. ½–1 mm thick; ♀ flowers 2–3 by 2 mm; perianth lobes 5, ovate, 1½–2 by 1 mm; ovary 2–3 by 2 mm, densely short, appressed-pubescent, glabrescent; stigmatic arms up to 1½ cm. *Infructescence* up to 5 cm long, axes c. 1 mm or thicker, bearing (1)–3–5 fruits. *Fruit* ± glabrous, c. 7 by 6 by 3 mm, short-beaked.

Distr. *Malesia*: N. Moluccas (Morotai), New Guinea (incl. Biak, Japen, and Polima Is.).

Ecol. Primary and secondary forests, locally often very common in rocky or stony habitats including limestone, 0–1000 m. *Fl.* fr. Jan.–Dec.

Vern. W. New Guinea: *warpis*, Biak, *tamanpara*, Japen, *ramē*, Iko.

Excluded

Gironniera glabra MERR. Philip. J. Sc. 1 (1906) Suppl. 42 = *Paratrophis glabra* STEEN. J. Bot. 72 (1934) 8 = *Chevalierodendron glabrum* LEROY, C. R. Ac. Sc. Paris 227 (1948) 146 = *Streblus glaber* (MERR.) CORNER, Gard. Bull. Sing. 19 (1962) 221 (*Moraceae*).

IRIDACEAE (D. J. L. Geerinck, Bruxelles)¹

Perennial herbs, often with bulbs, tubers or rhizomes, sometimes undershrubs. *Leaves* simple, equitant (except in *Crocus*), with parallel nerves. *Inflorescences* terminal or axillary, in cymes, spikes or panicles, sometimes very contracted or flowers solitary, bracteate and with 1 or 2 spathes. *Flowers* bisexual, actinomorphic to zygomorphic, often marcescent. Tepals free or united into a tube, in 2 whorls, the inner ones rarely inconspicuous (*Patersonia*). *Stamens* 3 or exceptionally 2 with 1 staminode (in the Australian *Diplarrhena*), free or united into a tube, basifixed or dorsifixed, opposite to the outer tepals. *Ovary* inferior (or superior in the Tasmanian *Isophysis*), 3-celled with axillary placentas; style entire or trifid, sometimes tepaloid; stigmas 3 or 6, terminal or sometimes axillary, alternating with or opposite to the outer tepals; ovules generally numerous. *Fruit* capsular, dehiscing loculicidally, apically or irregularly. *Seeds* angular, flat or globose, sometimes winged.

Distribution. Cosmopolitan, with c. 60 genera and c. 800 *spp.*, predominantly in the tropics and the southern hemisphere. In *Malesia*: only two Australasian genera each with 1 *sp.*, and four exotic ones introduced and naturalized.

Many are cultivated in botanic gardens and occasionally in private gardens; see for an elaborate treatment BACKER, Handb. Fl. Java 3 (1924) 116–130 and BACKER & BAKH. f. Fl. Java 3 (1968) 144–154.

Ecology. Both native species are characteristic mountain plants.

Morphology. This family is usually herbaceous, but in a few genera (*Klattia*, *Nivenia*, *Patersonia*, *Witsenia*) stems may be woody at the base. The leaves are equitant and are laterally compressed, the two halves are free at the sheathing base and gradually fused to the top. The flowers are actinomorphic to distinctly zygomorphic with intermediate forms, sometimes in the same genus.

Uses. *Belamcanda chinensis* and *Eleutherine palmifolia* are used for medicinal purposes, probably mainly on account of their glucosides; cf. HEYNE, Nutt. Pl. (1927); BURKILL, Dict. (1935); QUISUMBING, Med. Pl. Philip. (1951).

KEY TO THE GENERA

1. Flowers all sessile. Tepals united into a tube. Capsules included in bracts or spathes.
 2. Flowers actinomorphic. Inner tepals inconspicuous. Stamens united into an undivided or trifid tube. Caespitose or rhizomatous herbs or undershrubs 1. *Patersonia*
 2. Flowers ± zygomorphic. Tepals unequal. Stamens free. Cormogenous herbs. 5. *Gladiolus*
1. Flowers all pedicelled. Tepals free or nearly so. Capsules exerted from bracts or spathes.
 3. Tepals clawed. Stamens free.
 4. Cormogenous herbs. Stamens appressed against the back of the style-arms. Ovary not beaked. Style trifid with bilobed arms 6. *Trimezia*
 4. Rhizomatous herbs. Stamens not appressed against the back of the style-arms. Ovary beaked. Style trifid with undivided arms 3. *Belamcanda*
 3. Tepals not clawed.
 5. Tepals shortly connate, subequal. Stamens united into a tube, rarely nearly free. Caespitose to rhizomatous herbs. 2. *Sisyrinchium*
 5. Tepals free, the inner ones smaller. Stamens free. Bulbous herbs 4. *Eleutherine*

1. PATERSONIA

R.Br. ex KER-GAWL. Bot. Mag. (1807) t. 1041, *nom. cons.*; Prod. Nov. Holl. (1810) 304; BTH. Fl. Austr. 6 (1875) 400; GEERINCK, Bull. Jard. Bot. Nat. Belg. 44 (1974) 41. — *Genosiris* LABILL. Nov. Holl. Pl. Sp. 1 (1804) 13, t. 9. — **Fig. 1–3.**

Caespitose to rhizomatous herbs or undershrubs. *Inflorescences* terminal, in few-flowered contracted cymes, each with 2 spathes. *Flowers* actinomorphic, sessile, bluish to purple, exceptionally yellow or whitish, Tepals dimorphic, united into a long and filiform tube at the base, the inner lobes inconspicuous. Stamens 3,

(1) With co-operation by the General Editor.



Fig. 1. *Patersonia lowii* STAPF on Mt Losir, Gajolands, N. Sumatra, at c. 2400 m altitude (Photogr. DE WILDE-DUYFJES, April 1975, n. 16390).

united into an undivided or trifid tube. *Ovary* cylindrical, lanate; style entire; stigmas 3, subfoliaceous, alternating with the outer tepals. *Capsules* loculicidal, included. *Seeds* angular or ellipsoidal.

Distr. Australia and Tasmania (12 spp.), and Malesia (1 sp.).

Ecol. Open, low shrubberies, heaths and sedge-lands, 2000–3500 m.

Note. In sterile state the habit of *Patersonia* is strikingly resembling that of the sedge genus *Machaerina*. A specimen mentioned by WENT f. (Nova Guinea 14, 1924, 114) as *Patersonia* from Mt Goliath (DE KOCK 50) belongs to *Machaerina*, as corroborated anatomically by Dr P. BAAS.

1. *Patersonia lowii* STAPP, Trans. Linn. Soc. Bot. II, 4 (1894) 241, t. 20, f. 7–9; MERR. Philip. J. Sc. 2 (1907) Bot. 268; EN. BORN. (1921) 119; EN. Philip. 1 (1923) 220; Not. Nat. Ac. Nat. Sc. Philad. n. 47 (1940) 2. — *P. borneensis* STAPP, Trans. Linn. Soc. Bot. II, 4 (1894) 241; GIBBS, J. Linn. Soc. Bot. 42 (1914) 165; MERR. EN. BORN. (1921) 119. — *P. novoguineensis* GIBBS, Arfak (1917) 101; WENT f. Nova Guinea 14 (1924) 114, incl. var. *auriculata* WENT, l.c.; HATUS. Bot. Mag. Tokyo 56 (1942) 426. — Fig. 1–3.

Tufted herb, 15–60 cm high. *Leaves* basal to subbasal, flat to \pm biconvex, 5–60 cm by 3–6 mm,

reddish or rarely whitish tomentellous to glabrescent along the margins towards the top, \pm glaucous. *Inflorescences* equalling the leaves or nearly so; peduncle 8–50 cm long, glabrous, the lower part surrounded by a persistent central leaf; spathes suboval to narrowly suboval, $2\frac{1}{2}$ –5 cm by 7–12 mm, dark brown-orange, greyish when growing old, distinctly striate, with a red-hairy line on the keel to glabrous. *Flowers* bluish to pale mauve or purple, sometimes whitish; perigonotube 2 – $2\frac{1}{2}$ cm long, the outer lobes 8–16 by 6–10 mm. Staminal tube entire; anthers yellow. *Ovary* c. 5 mm long. *Capsules* 2–3 cm long; valves 3–4 mm wide. *Seeds* c. 2 mm, black.

Distr. *Malesia*: Sumatra (Gajolands: Mt Losir), Borneo (Mts Kinabalu and Murud, Kalabit Highlands), Philippines (Mindoro), New Guinea (Tamrau Range, Arfak Mts, Mamberamo River, Central to Milne Bay Districts). Fig. 4.

Ecol. Open shrubby vegetation or open forests, sedge meadows and heaths, on stony or impervious



Fig. 2. *Patersonia lowii* STAPP. a Habit, b, capsule, both nat. size, c, seed, $\times 5$ (a VAN ROYEN & SLEUMER 7102, b–c BRASS 22259).



Fig. 3. *Patersonia lowii* STAPP. Same locality as in fig. 1.

clay soils, often gregarious, 2000–3500 m. *Fl. fr.* Dec.–Aug. Flowers open early in the morning but become soon marcescent.

Vern. New Guinea: *atetdzii*, Mt Arfak, Manikiang lang.

Notes. The sizes of the tepals and of the seeds have been taken from the original descriptions of the synonymous taxa.

A variable species concerning the indument; the disjunct populations are not uniform. It seems to be allied to the widely distributed Australian *P. fragilis* (LABILL.) ASCHERSON & GRAEBNER, which differs by glabrous leaves and spathes, inflorescences much shorter than the leaves and the lower part of the peduncles never surrounded by a central leaf.

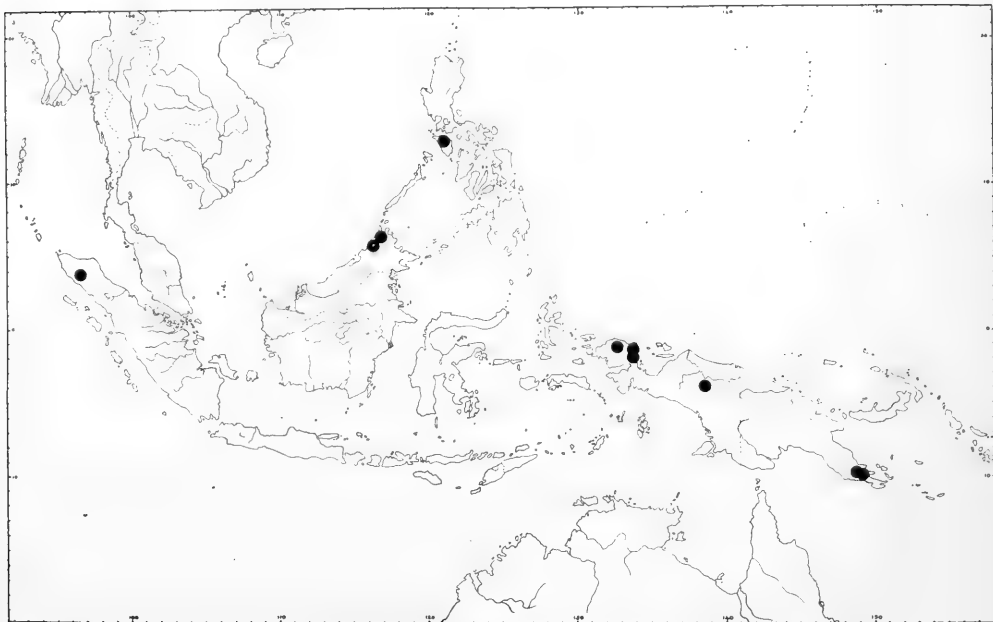


Fig. 4. Range of *Patersonia lowii* STAFF.

2. SISYRINCHIUM

LINNÉ, *Sp. Pl.* (1753) 954; JOHNSTON, *J. Arn. Arb.* 19 (1938) 376; FOSTER, *Contr. Gray Herb.* 166 (1948) 28. — *Renealmia* R.BR. *Prod.* (1810) 592, *pro parte, non* L. *f.* 1781. — Fig. 5–6.

Caespitose to rhizomatous herbs. *Inflorescences* axillary or terminal in panicles of fan-shaped and few-flowered cymes or of many-flowered clusters, each with 1–2 spathes. *Flowers* actinomorphic, pedicelled, bluish or yellowish. *Tepals* subequal, shortly connate at the base. *Stamens* 3, united into a tube at the base, rarely nearly free. *Ovary*: style trifid, the lobes filiform; stigmas 3, small, alternating with the outer tepals. *Capsules* exserted. *Seeds* small, globose.

Distr. About 100 *spp.* in Central and South America, 1 native *sp.* in New Zealand, Australia and East Malesia (New Guinea); also one species introduced.

The Papuan-Australasian species was mostly arranged in the closely allied genus *Libertia* SPR. However, the tepals are not dimorphic but about similar so that it must be arranged in *Sisyrrinchium*.

KEY TO THE SPECIES

1. Leaves cauline, distichous. Inflorescences in 1-2-flowered, contracted cymes, a few at a cauline leaf. Flowers c. 5 mm long. Stamens nearly free, glabrous 1. *S. pulchellum*
 1. Leaves mostly basal. Inflorescences in 3-6-flowered cymes, generally 2 at a cauline leaf. Flowers c. 7 mm long. Stamens united in a hairy tube, trifold at the top 2. *S. micranthum*

1. *Sisyrinchium pulchellum* (R.Br.) F.v.M. Fragm. Phyt. Austr. 7 (1870) 92; Trans. R. Soc. Victoria 1 (1889) 34; GEERINCK, Bull. Jard. Bot. Nat. Belg. 44 (1974) 59. — *Renealmia pulchella* R.Br. Prod. (1810) 592, to replace *S. pulchellum* R.Br. l.c. 305. — *Libertia pulchella* Spr. Syst. Veg. 1 (1824) 169; LANE-POOLE, For. Res. (1925) 77; LAUT. Bot. Jahrb. 62 (1929) 462; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 220; HOOGL. Blumea 4 (1958) 235; BALGOOY, Pac. Pl. Areas 2 (1966) 286; L. MOORE, New Zeal. J. Bot. 5 (1967) 267. — Fig. 5a.

Glabrous herb, 10-35 cm high. Leaves cauline, distichous, linear, 4-22 cm by 1-10 mm. Inflorescences in 1-2-flowered, contracted cymes, a few at a cauline leaf, each cyme with 1 spathe: this 4-15 (-40) by 2-6 mm. Pedicels to 4 cm. Flowers c. 5 mm long. Tepals white to yellowish, c. 4 by 1½-2 mm. Stamens nearly free, filaments c. 4 mm, anthers 1 mm long. Ovary ellipsoid, c. 1 mm long; style with undivided part 1-2 mm, the lobes 1-2 mm long. Capsules globular, 2-5 mm Ø; valves c. 2 mm wide. Seeds black, 1 mm Ø.

Distr. New Zealand, Australia (New South Wales, Victoria, Tasmania), and East Malesia: New Guinea (Lake Habbema area and Mt Antares in West, many localities in East). Fig. 6.

Ecol. Open forests and shrubby vegetation, in tree fern heath and alpine grassland, common on Mt Sarawaket in *Libocedrus-Dacrydium* forest (LANE-POOLE), 2400-3700 m. Fl. mostly Jan.-Aug.

Note. MOORE (l.c. 255-275) studied the variation in New Zealand and distinguished three species among which are two polyploids.



Fig. 6. Range of *Sisyrinchium pulchellum* (R.Br.) F.v.M.



Fig. 5. *Sisyrinchium pulchellum* (R.Br.) F.v.M. a. Inflorescence, nat. size. — *S. micranthum* Cav. b. Inflorescence, nat. size (a KALKMAN 4497, b VAN ROYEN 16028).

2. *Sisyrinchium micranthum* Cav. Diss. Bot. 6 (1788) 345, t. 191; BACK. Handb. Fl. Java 3 (1924) 125; JOHNSTON, J. Arn. Arb. 19 (1938) 390; FOSTER, Contr. Gray Herb. 166 (1948) 31; WILLIS, Handb. Fl. Victoria 1 (1962) 335; STEEN. Blumea 15 (1967) 154; BACK. & BAKH. f. Fl. Java 3 (1968) 150. — Fig. 5b.

Slender herb, 5-25 cm high, glabrous, with a flat stem. Leaves few, mostly basal, linear, 3-12 cm by 1-5 mm. Inflorescences in 3-6-flowered cymes, generally 2 at a cauline leaf, each cyme with 2 spathes, outer spathe 20-30 mm long, inner spathe 15-25 mm long, both 1-2 mm wide. Flowers c. 7 mm long. Tepals yellow with red or brown markings, c. 6 by 1 mm. Stamens united in a hairy tube, trifold at the top; filaments c. 1 mm long; anthers ½ mm long. Ovary ellipsoid, laxly hairy, c. 1 mm long; style with the undivided part c. 1 mm long, the lobes c. ½-¾ mm long. Capsules globose, 2-3 mm long; valves c. 2 mm wide. Seeds black, 1 mm Ø.

Distr. Southern to Central America; naturalized in Australia, New Caledonia, Fiji, New Zealand, and also in Malesia: W. Java (Tjibodas), E. New Guinea (Morobe Distr.: Edie Creek), perhaps elsewhere.

Ecol. In the vicinity of the Tjibodas Botanic Garden as a weed in grassland and waste places, at c. 1450 m, certainly escaped from the garden. In Papua at c. 1950 m almost certainly introduced from Australia where it was first recorded about 1870. Poisonous to stock.

3. BELAMCANDA

ADANS. Fam. 2 (1763) 60.

Rhizomatous herbs. *Inflorescences* terminal, in panicles of flowered and corymbiform cymes, each with 2 spathes. *Flowers* actinomorphic, pedicelled, yellowish to orange. Tepals subequal, shortly connate, clawed. *Stamens* free. *Ovary* beaked; style trifid, the lobes short; stigmas 3, small, alternating with the outer tepals. *Capsules* exserted. *Seeds* large, globose.

Distr. Monotypic, native of China and Japan, cultivated in *Malesia* and many other countries and sometimes naturalized.

1. *Belamcanda chinensis* (L.) DC. in Redouté, Liliac. 3 (1805) t. 121; KOORD. Minah. (1898) 313; C. B. ROB. Philip. J. Sc. 6 (1911) Bot. 196; KOORD. Exk. Fl. Java 1 (1911) 312; MERR. Fl. Manila (1912) 152; Philip. J. Sc. 11 (1916) Bot. 260; En. Philip. 1 (1923) 220; BACK. Handb. Fl. Java 3 (1924) 124; HEYNE, Nutt. Pl. (1927) 461; GAGNEP. Fl. Gén. I.-C. 6 (1934) 675; BURK. Dict. (1935) 315; STEEN. Fl. Sch. Indon. (1949) 147; QUIS. Med. Pl. Philip. (1951) 181; HENDERS. Mal. Wild Fl. Monoc. (1954) 168, f. 98; OHWI, Fl. Japan (1965) 316; BACK. & BAKH. f. Fl. Java 3 (1968) 149. — *Balem-canda schulermani* RHEEDE, Hort. Mal. 11: 73, t. 37. — *Ixia chinensis* LINNÉ, Sp. Pl. (1753) 36. — *Pardanthus chinensis* KER-GAWL. in König & Sims, Ann. Bot. 1 (1805) 247; BL. En. Pl. Jav. (1827) 26; ZOLL. Syst. Verz. 1 (1854) 70; FILET, Pl. Bot. Tuin Weltevreden (1855) 13; MIQ. Fl. Ind. Bat. 3 (1859) 579; BLANCO, Fl. Filip. ed. 3 (1877–83) t. 376.

Corymbosely branched, glabrous herb, 1–1½ m high. *Leaves* distichous, basal and cauline, broadly linear, 30–60 by 2–4 cm, glaucous. *Inflorescences* in 6–12-flowered cymes, once or twice branched; spathes membranous, c. 10 by 4 mm. Pedicels 2–4 cm, persistent. Tepals yellowish to orange, with red spots, unguiculate, obovate, 25–35 by

c. 7 mm, outer ones largest. *Filaments* filiform; anthers c. 10 mm long. *Ovary* ellipsoid, c. 5 mm long; style-arms gradually thickened upwards. *Capsules* obovate, 15–20 mm long; valves 8–12 mm wide. *Seeds* shining black, 5 mm Ø.

Distr. Native in China and Japan; in *Malesia* introduced and cultivated, locally naturalized (Sumatra, Java, S. Celebes, Philippines, Moluccas: Morotai, Banda, Ceram); cultivated and locally naturalized in many tropical and subtropical countries, e.g. Hainan, Taiwan (Formosa), Tonga, etc.

Ecol. In Java it is mainly naturalized in the eastern part between 750 and 2100 m, occurring in thickets and forest edges, and said not to grow well at low altitude.

The flowers open in the forenoon and have withered by midday.

Uses. HEYNE and BURKILL (*ll.cc.*) mention usage for several minor medicinal purposes, the dried rhizome being used as a purgative and for complaints of the chest and liver, etc.

Vern. Sumatra: *piso-piso*, Batak. Java: *akar tjamaka*, *djamaka*, *gëgëngan brodjo lintang*, *suliga*, S, *sëmprit*, *wordi*, J. Celebes: *karimënga kulo*, *katna*, *këtêp*, *këtêw*, *kiris*, Minahasa, Alf. lang., *tagari*, Bonthain. Philippines: *abinaco*.

4. ELEUTHERINE

HERBERT, Bot. Reg. 29 (1843) t. 57, *nom. cons.*

Bulbous herbs. *Inflorescences* axillary in few-flowered and contracted cymes, each in 2 spathes. *Flowers* actinomorphic, pedicelled, whitish. Tepals free, the inner ones smaller. *Stamens* 3, free. Style deeply trifid; stigmas 3, small, alternating with the outer tepals. *Capsule* loculicidal, exsert. *Seeds* ellipsoidal to angular.

Distr. In America 2 *spp.* and according to GAGNEPAIN (Fl. Gén. I.-C. 6, 1934, 676) 2 *spp.* in Indo-China. Introduced in *Malesia*, and locally naturalized.

1. *Eleutherine palmifolia* (L.) MERR. Philip. J. Sc. 7 (1912) Bot. 233; Fl. Manila (1912) 153; Sp. Blanc. (1918) 104; En. Philip. 1 (1923) 220; QUIS. Med. Pl. Philip. (1951) 182; BACK. & BAKH. f. Fl. Java 3 (1968) 150. — *Sisyrinchium palmifolium* LINNÉ, Mant. 1 (1767) 122. — *Sisyrinchium bulbosum* MILL. Gard. Dict. ed. 8 (1768) n. 3. — *Ixia americana* AUBL. Pl. Guian. 1 (1775) 33. — *Moraea plicata* Sw. Fl. Ind. Occ. 1 (1797) 82. — *Antholyza meriana* (non L.) BLANCO, Fl. Filip. (1837) 24; ed. 3,

1 (1877) t. 100; MERR. Publ. Gov. Lab. Philip. 27 (1905) 85. — *E. plicata* HERBERT, Bot. Reg. 29 (1843) t. 57. — *E. bulbosa* (MILL.) URBAN in Fedde, Rep. 15 (1918) 305; LÉONARD, Bull. Soc. R. Bot. Belg. 84 (1951) 55. — *E. americana* MERR. ex HEYNE, Nutt. Pl. Ned. Ind. ed. 2, 1 (1922) 502; BACK. & SLOOT. Handb. Thee (1924) 91, t. 91; BACK. Handb. Fl. Java 3 (1924) 126; HEYNE, Nutt. Pl. (1927) 462.

Herb, 30–60 cm high, glabrous; bulb red, ovoid,

2½–5 cm long. *Leaves* basal 3–4 from each bulb, and cauline, narrowly elliptic, plicate-nerved, 25–60 by 1–2½ cm. *Inflorescences* in 4–10-flowered cymes; spathes 12–16 mm long, green. *Flowers* very fugacious, white. Tepals obovate, c. 15 mm long. *Stamens* yellow to orange, 8–10 mm long. *Ovary* ellipsoidal, c. 2 mm long; style-arms filiform, yellow; stigmas white. *Capsules* globose, c. 6 mm long. *Seeds* dark brown, c. 2 mm Ø.

Distr. Native in tropical America, cultivated and naturalized in tropical Africa and in *Malesia*: W. Java, W. Borneo, and the Philippines (Luzon, Leyte, Negros, Mindanao); in Java already noticed ± 1820.

Ecol. A weed, finally tufted, in estates and waste places, which multiplied by its tubers; c. 150–1500 m. In Java the scentless flowers open at about 5 o'clock in the afternoon, but have already wilted at about 7 o'clock.

Uses. According to QUISUMBING *l.c.* in the Philippines macerated bulbs are applied on the stomachs of children to relieve gas pains, and a decoction is diuretic. According to HEYNE *l.c.* this finally strongly stooling, tufted plant is cultivated and its bulbs have various applications in native medicine: diuretic, purgative, emetic, against dysentery, jaundice, etc.

Vern. *Vijfuursbloem*, D. Java: *babawangan*, *b. beureum*, *bawang sabrang*, *b. sieum*, S. *bawang kapal*, M. *brambang sabrang*, *luluwan sapi*, *tēki sabrang*, J. Philippines: *ahos-āhos*, C. Bis., *bakong sa Persia*, *mala-bauang*, *rosas sa Siam*, Tag., *hagu-sahis*, S. L. Bis., *palmilla*, Spanish.

Note. The tepals are sometimes numerous, up to 15; the number of the stamens is sometimes up to 8; the ovary is sometimes 4–11-locular with the same number of style-arms.

5. GLADIOLUS

LINNÉ, Sp. Pl. (1753) 36; GEERINCK, Bull. Jard. Bot. Nat. Belg. 42 (1972) 269; LEWIS & OBERMEYER, J. S. Afr. Bot. Suppl. 10 (1972).

Cormogenous herbs. *Inflorescences* terminal or sometimes axillary in spikes, rarely secund. *Flowers* ± zygomorphic, sessile, various in colour, each in a single spathe. Tepals unequal, united into an often curved tube. *Stamens* 3, often arched, free. Style entire; stigmas 3, obovate, alternating with the outer tepals. *Capsule* loculicidal, included. *Seeds* often winged.

Distr. About 180 spp. in Africa, South Europe and West Asia, one locally naturalized in *Malesia*.

1. *Gladiolus natalensis* (ECKLON) REINW. *ex* HOOK. Bot. Mag. (1831) t. 3084; GEERINCK, Bull. Jard. Bot. Nat. Belg. 42 (1972) 281; LEWIS & OBERMEYER, J. S. Afr. Bot. Suppl. 10 (1972) 44.

var. natalensis.

Stems 50–150 cm. *Leaves* almost basal, broadly linear, up to 30 by 4–5 cm. *Inflorescences* terminal in 2–25-flowered spikes; spathes 4–8 cm long. *Flowers* yellowish to pinkish, often with brown

markings. Perigone-tube curved, 2–5 cm long, lobes unequal, the upper 4½–5 cm, the outer laterals 3–4½ cm, the inner laterals 2–3 cm and the lower 2½–3½ cm long. *Filaments* curved, 4½–6 cm; anthers 1¼–1¾ cm. *Ovary* ellipsoid, 5–8 mm long; style curved, 2–7 cm; stigmas 5–7 mm. *Capsule* ellipsoid, 2–5 cm long; valves 7–10 mm wide. *Seeds* flat, winged, golden brown, 7–10 mm Ø.

Distr. Tropical and southern Africa, naturalized in *Malesia*: Philippines (Luzon).

6. TRIMEZIA

SALISB. *ex* HERBERT, Bot. Reg. 30, Misc. (1844) 88; DIELS, Pfl. Fam. ed. 2, 15a (1930) 497; FOSTER, Rhodora 64 (1962) 307.

Cormogenous herbs. *Inflorescences* axillary in few-flowered cymes, each in 2 spathes. *Flowers* actinomorphic, pedicelled, yellowish to reddish. Tepals free, clawed, the inner ones shorter and narrower with recurved tops. *Stamens* free, against the back of the style-arms. Style trifid, the lobes broadly flat, bilobed; stigmas small, opposite to the outer tepals. *Capsules* apically dehiscent, with 3 pores exerted beyond the spathe. *Seeds* globose to angular.

Distr. A few species in Central and tropical America, one introduced in *Malesia* (Malaya, West Java).

1. *Trimezia martinicensis* (JACQ.) HERBERT, Bot. Reg. 30, Misc. (1844) 88; BACK. Handb. Fl. Java 3 (1924) 121 ('*Trimeza*'); HENDERS. Mal. Wild Fl. Monoc. (1954) 168, f. 98; FOSTER, Rhodora 64 (1962) 308; BACK. & BAKH. f. Fl. Java 3 (1968) 148. — *Iris martinicensis* JACQ. En. Pl. Carib. (1760) 12. — *T. lurida* SALISB. Trans. Hort. Soc. 1 (1812) 308; HENDERS. Gard. Bull. S. S. 4 (1928) 341. — *Cipura martinicensis* KTH in H. B. K. Nov. Gen. Sp. 1 (1816) 320.

Glabrous herb, 100–150 cm. *Leaves* basal to cauline, linear, 20–100 cm long and 8–12 mm wide. *Inflorescences* in 3–6-flowered cymes, solitary or binate; spathes $2-2\frac{1}{2}$ cm long, 10–25 cm peduncled. Pedicels $1\frac{1}{2}-3\frac{1}{2}$ cm. *Flowers* yellow, brownish at the base. Outer tepals obovate, erect

to patent, 19–25 mm long and 10–13 mm wide; inner tepals narrower, S-shape curved. *Stamens* 3–4 mm long. *Ovary* ellipsoidal; style-arms 5–7 mm long, shortly bilobed. *Capsule* ellipsoid, 13–20 mm long. *Seeds* brown, superficially ribbed.

Distr. Native of Mexico, cultivated and locally naturalized in *Malesia*: Malaya, West Java.

Ecol. In sunny or slightly shaded localities, between grass, originally in Malaya at Kuala Lumpur, but now not uncommon in Malaya (HENDERSON), in West Java at Bogor on and around a native cemetery (BACKER), in both cases escaped from a Botanic Garden, below 250 m. Flowers expand in the forenoon and have withered by midday.

Vern. Forenoon yellow flag, E.

CORNACEAE (K. M. Matthew, Tiruchirapalli, India)¹

In the past century *Cornaceae* were mostly delimited in a wide sense and they represented a fairly heterogeneous assemblage. HARMS (Ber. Deut. Bot. Ges. 15, 1897, 28 and in E. & P. Nat. Pfl. Fam. 3, 8, 1898, 255) distinguished 7 subfamilies. Of these *Garryoideae* were later mostly recognized as a separate family *Garryaceae*, *Alangioideae* as *Alangiaceae*, *Nyssoideae* and *Davidioideae* together as *Nyssaceae*, leaving *Cornaceae* with the remaining three subfamilies *Cornoideae*, *Curtisioideae* (monotypic, South Africa) and *Mastixioideae* (monotypic, Indo-Malesian tropics). Cf. WANGERIN, Pfl. Reich Heft 41⁴ (1910) 18.

In recent years, however, the other genera (6) of the *Cornoideae*, besides *Cornus*, have also been recognized as monotypic families, with the exception of *Corokia* which was transferred to *Saxifragaceae-Escallonioideae*. Notably TAKHTAJAN (Proiskh. Prokruitosem. Rast.: 89, *non vidi*) is in favour of these monotypic families. In his 'Flowering Plants' (ed. C. JEFFREY; 1969: 227) he accepted 7 segregate families besides *Cornaceae sens. str.* (omitting mention of two Madagascan genera, one of which he had formerly also raised to family rank, according to SHAW, 1973). These 7 families he arranged, together with *Araliaceae* and *Umbelliferae*, in the order *Cornales*, a phylogenetic construction of affinity not much different from earlier conceptions. The general impression is thus that the distinction of the segregate families is largely an inflation in rank.

We have not followed this tendency towards inflation advocated by a few contemporary systematists and have accepted *Cornaceae* in the wide sense. We do not feel that inflation has the merit of improving scientific insight in the mutual systematical affinities, which remain as they were, either as tribes or as subfamilies, representing together one phylogenetical whole. In addition the disadvantage of the inflation is that the multiplication of family names becomes unnecessarily a real challenge to our capacity to memorize, and deflates firmly established family concepts.

We briefly mention that further relationships are sometimes suggested with quite remote groups. RENDLE (Class. Fl. Pl. 2, 1952, 422) suggested alliance with *Caprifoliaceae*, e.g. *Viburnum*; affinity has also been suggested with *Saxifragaceae-Escallonioideae*. It falls beyond the scope of the present account to elaborate further the extensive literature on the subject.

Cornaceae are in great majority northern extratropical, in which zone also many fossils are known. There are some stray genera on the southern hemisphere. *Mastixia* is tropical but was found in abundance in the Tertiary in the subtropics and warm-temperate regions of the northern hemisphere. See under the genus.

Note. Besides the native genus *Mastixia* the family is represented in Java by *Aucuba japonica* THUNB. which is sometimes cultivated in the mountains. Cf. BACK. & BAKH. f. Fl. Java 3 (1965) 159. — Ed.

1. MASTIXIA

BLUME, Bijdr. (1826) 654; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1898) 262; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 19; HALL. f. Beih. Bot. Centralbl. 34, 2 (1916) 40; DANSER, Blumea 1 (1934) 47; MATTHEW, Blumea 23 (1976) 51, f. 1-6. — Fig. 1, 3.

(1) Composed from the precursory revision in Blumea 23 (1976) 51-93 by the General Editor.

Thanks are due for the financial assistance by the Netherlands Organization for the Advancement of Pure Research (Z.W.O.).

Unarmed, resinous, evergreen trees up to 40(–60) m; branchlets with pith. *Leaves* simple, exstipulate, entire, acute, alternate or (sub)opposite to decussate, sometimes with domatia. *Thyrses* terminal on the main shoots, sometimes also on the laterals, up to 4(–8) times branched, the branches of the first order either (sub)opposite ('*Oppositae*') or spirally arranged ('*Alternae*'); further branchings with a tendency towards decussate arrangement and terminated by cymes; cymes with the central flower most often sessile and ebracteolate, lateral flowers pedicelled and bracteolate. Bracts and bracteoles ovate to triangular, connate or free, lower bracts sometimes gradually becoming foliaceous. *Flowers* bisexual, greenish to yellowish. *Calyx* 4–5(–6–7)-toothed or -lobed, persistent. *Petals* valvate, 4–5(–6), thick, ovate to oblong-elliptic, inflexed at apex and 2-dentate or fimbriate, sometimes with a

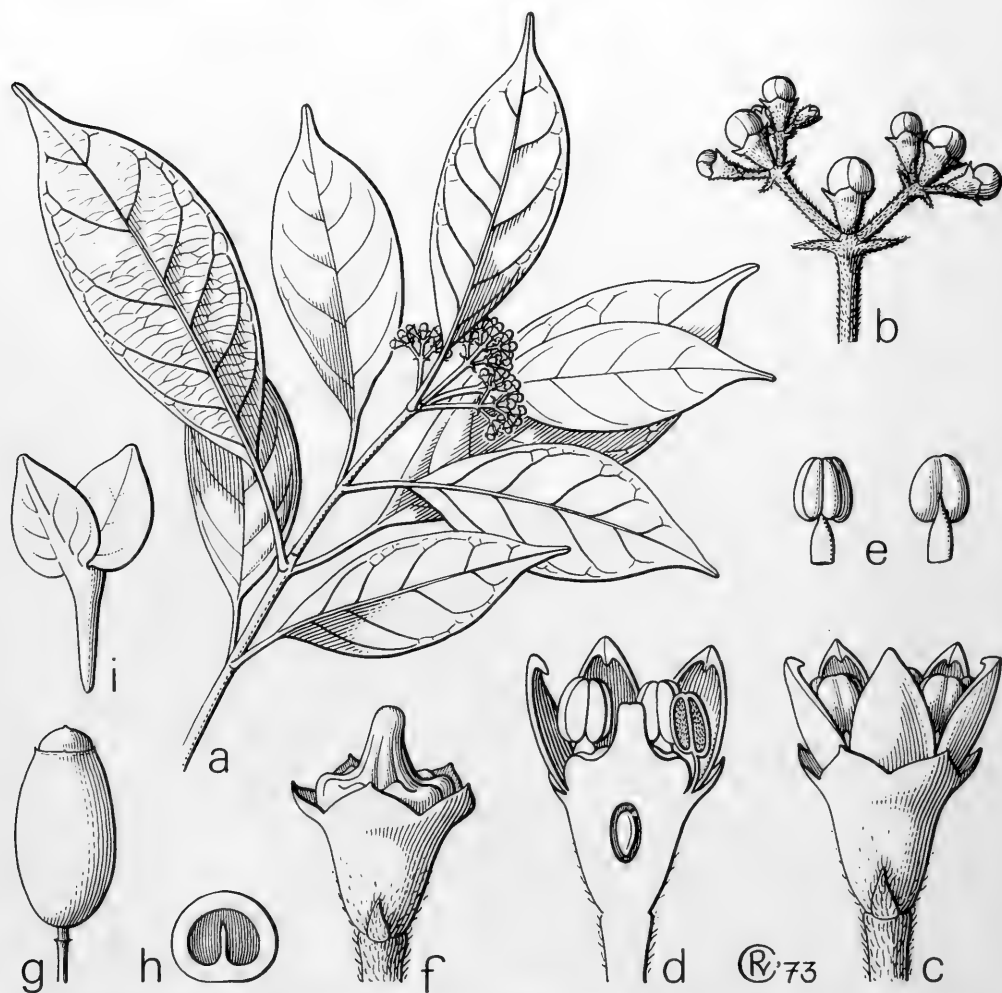


Fig. 1. *Mastixia kaniensis* MELCH. ssp. *kaniensis*. a. Habit, $\times \frac{2}{3}$, b. terminal cymes, $\times 3$, c. flower, d. ditto in LS, e. stamen in dorsal and frontal view, f. receptacle containing ovary, disk, and style, all $\times 6$, g. fruit, $\times \frac{2}{3}$, h. CS of fruit, $\times \frac{2}{3}$, i. embryo, $\times 6$ (a–b BSIP 3080, c–f CLEMENS 1890, g–i BSIP 2809).

median ridge inside, spreading or reflexed. *Stamens* 4-5(-6), or 8, alternating with the petals, erect in bud; when 8 in 2 alternate whorls of 4; filaments subulate, flattened; anthers cordate, dorsifixed, abutting on and alternating with the disk lobes, latrorse; connective \pm protruding. *Ovary* inferior, turbinate, 1-celled, surmounted by a prominent, fleshy, persistent disk c. $\frac{1}{3}$ the height of the receptacle; invaginations of the disk abaxially 4-5 (fitting the filaments) and adaxially 8 or 10 (fitting the thecae), becoming shallower with age; style stout, ribbed; stigma punctiform, sometimes deeply 2-fid or 4-5-lobed, lobes sometimes reflexed. *Ovule* 1, pendulous laterally from the roof of the cell. *Drupe* subglobose to oblong, surmounted by calyx and disk; pericarp thin or thick, dark purple to blue when ripe; endocarp woody, sulcate on one side externally and internally deeply protruding into the fruit cavity as a wedge-shaped or swollen incomplete septum. *Seed* fitting the fruit cavity; testa membranous; endosperm copious; embryo small; cotyledons foliaceous; radicle elongate.

Distr. About 13 spp. in SE. Asia (Western Ghats & Ceylon, NE. India, Bhutan, Burma, Thailand, Indo-China, S. Yunnan, Hainan) through Malesia to New Britain and the Solomon Islands. Fig. 2.

Ecol. Primary and secondary forest, often in moist habitats, from sea-level up to 1800(-2400) m.

Fossil endocarps of *Mastixioids* are found in quantity in the warmer Tertiary in Europe, Great Britain and North America. Cf. KIRCHHEIMER, *Die Laubgewächse der Braunkohlzeit* (1957) and D. H. MAI, *Paläontol. Abhandl. Deut. 2* (1) (1964). The Pleistocene Glacial Epoch is held responsible for the contraction of the range, similarly as happened to *Symplocos*, *Meliosma*, and so many other genera of the Tertiary mixed mesophytic forest on the northern hemisphere.

Taxon. *Mastixia* was subdivided into two subgenera by WANGERIN (1910) on the 4- and 5-merousness of the flowers respectively. Though this character is still used for discrimination of species, it seems

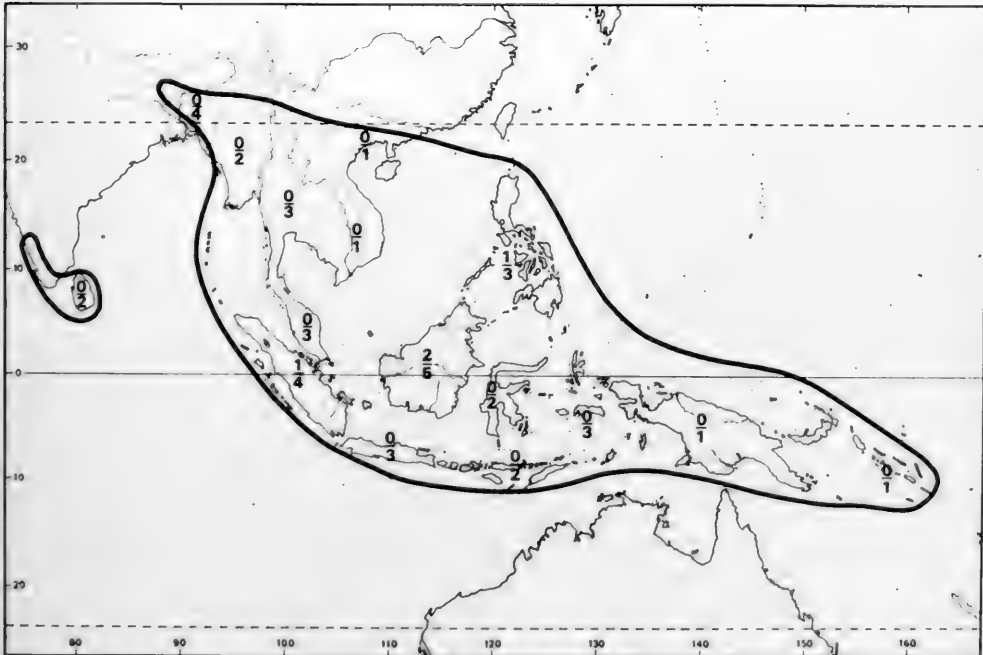


Fig. 2. Range of the living species of the genus *Mastixia* BL. For each district, island or island group the number of species is given, above the hyphen the endemic ones, below the hyphen the non-endemic ones (occurring in more than one district).

artificial for subgeneric rank. Instead, I have proposed another subdivision (1976) into two subgenera, in one of which (*subg. Manglesia*) the stamens number 8 and are arranged into 2 whorls, while in *subg. Mastixia* the stamens number 4-5(-6) and stand in 1 whorl. Other differential characters support this subdivision; see also the key.

Anatomy. For general anatomical surveys also giving the older literature see SOLEREDER, *Syst. Anat. Dicot.* Stuttgart (1899) 487-495 and *ibid.* (1908) 171-172; METCALFE & CHALK, *Anat. Dicot.* Oxford (1950) 735-741. Additional selected references: MOLL & JANSSONIUS, *Mikr.* 3 (1918) 722-737 (wood anatomy); ADAMS, J. Elisha Mitchell *Sci. Soc.* 65 (1949) 218-244 (comparative wood anatomy); JANSSONIUS, *Blumea* 6 (1950) 424 (wood anatomical affinities); VERSTEEGH, *Acta Bot. Neerl.* 17 (1968) 151-159 (wood anatomy).

The wood of *Mastixia* like that of most other *Cornaceae* is primitive. It has diffuse, exclusively solitary vessels with scalariform perforations (many-barred), fibre-tracheids, diffuse parenchyma, and heterogeneous rays. MOLL & JANSSONIUS *l.c.* reported vertical intercellular canals in *Mastixia rostrata* and *M. trichotoma*. The latter are absent from *M. tetrapetala* studied in Leiden. The leaf and twig anatomy of *Mastixia* is characterized by the occurrence of secretory canals. This important feature is absent from the other genera of the *Cornaceae*. Their presence in *Mastixia* can be used as an argument to stress the affinities of *Cornaceae* with *Araliaceae* and *Umbelliferae* of the *Cornales* for which families they are typical. — P. BAAS.

Galls. Only two galls have been described by DOCTERS VAN LEEUWEN (*Ned. Kruidk. Arch.* 51, 1941, 207) in the species where they most occur, *viz M. rostrata* and *M. trichotoma*, both caused by aphids. They occur, however, rather random in many species and varieties, with preponderance in *ser. Oppositae*. None have been found yet in species of *subg. Manglesia*. There are four kinds: on the stem, the leaf, the inflorescence, and the fruit. Sometimes they can be quite large, as has been cited under the species. See fig. 3.

Uses. Although trees may reach a considerable size, the scattered occurrence does not contribute to general use as timber; besides, the timber is not of good quality and is only used for minor purposes. *Cf.* BURKILL, *Dict.* (1935) 1428.

Notes. In key and descriptions the width of the submature flower is that of the corolla.

About the use of the term 'merousness' of the flower it should be remarked that this cannot be used in the strict sense, as 4- and 5-merous flowers often occur in one inflorescence. If it is said 'basically 4-merous', this means that at least 80% of the flowers are 4-merous and the same holds for basically 5-merous flowers, so that the prevalent pattern is obvious.

Moreover it should be remarked that the number of sepals frequently tends to be higher than that of petals and stamens.

In exceptional cases identification of sterile or immature material must remain uncertain.

Unfortunately no separate key can be provided for fruiting material.

KEY TO THE SPECIES

1. Stamens 8, in 2 whorls of 4. Inflorescence branches 4-angular (at least when young). Calyx subtruncate with minute, acute teeth. Bracts caducous. Pedicels of lateral flowers of terminal cymes over 5 mm, slender. Septum of endocarp swollen to at least $\frac{1}{3}$ of the diameter of the fruit. Branchlets subterete. Domatia occasional, suborbicular. **SUBG. MANGLESIA** **1. *M. octandra***
1. Stamens 4-5(-6), in one whorl. Inflorescence branches terete. Calyx distinctly lobed. Bracts subsistent. Septum of endocarp wedge-shaped. **SUBG. MASTIXIA**
2. Inflorescence branches of the first order (sub)opposite or decussate. Branchlets and leaves generally (sub)opposite or decussate; nodes flattened. Fruits generally ovoid. *Ser. Oppositae*.
3. Flowers basically 5-merous.
4. Sepals less than half as long as wide. Inflorescence subglabrous to puberulous. Fruit ovoid to oblong, with inconspicuous persistent sepals **2. *M. kaniensis***
4. Sepals almost as long as wide. Inflorescence velutinous to woolly. Fruit elongate-ovoid, with conspicuous persistent sepals **3a. *M. trichotoma* var. *korthalsiana***
3. Flowers basically 4-merous.
5. Sepals almost as long as wide. Inflorescence puberulous to woolly. Corolla puberulous to villous outside. Leaves acute or shortly acuminate, 5-24 by 2-12 cm. Fruit with conspicuous persistent sepals **3. *M. trichotoma***
5. Sepals less than half as long as wide. Inflorescence (sub)glabrous. Corolla glabrous outside. Leaves abruptly caudate to cuspidate, 4-12 by 2-5 $\frac{1}{2}$ cm. Fruit with obscure calyx teeth.
6. Leaves strictly opposite; petioles stout. Leaves thick-coriaceous; nervation prominent, with intermediary nerves. Inflorescence stout with lower bracts up to 5 mm. Fruit 1 $\frac{1}{2}$ cm \varnothing **4. *M. eugenioides***
6. Leaves (sub)opposite or alternate; petioles slender. Leaves chartaceous to subcoriaceous; nervation rather weak, without intermediary nerves. Inflorescence slender with bracts all under 3 mm. Fruit up to 1 cm \varnothing . **5. *M. rostrata***
2. Inflorescence branches of the first order scattered. Branchlets and leaves scattered; nodes terete. Fruit generally ellipsoid or oblong. *Ser. Alternae*.
7. Branchlets woolly. Leaves 13-30 by 5 $\frac{1}{2}$ -15 cm, with midrib and nerves (even veinlets) woolly to villous; petioles stout, 4 cm or longer, woolly. Fruit over 4 by 2 cm. Flowers 5-merous **6. *M. macrocarpa***

7. Branchlets not woolly. Petioles up to 4 cm. Fruit up to 4 cm long.
8. Flowers basically 4-merous.
9. Leaves glaucous and waxy below, thick-coriaceous, with intermediary nerves; apex apiculate. Sepals as long as wide 7. *M. glauca*
9. Leaves not glaucous and waxy below, without intermediary nerves; apex other than apiculate. Calyx teeth at most half as long as wide.
10. Leaves crowded at apices of branchlets, thick-coriaceous; acute to acuminate. Inflorescence branches stout, compact. Fruit ellipsoid, $1\frac{1}{2}$ cm \varnothing 8. *M. tetrapetala*
10. Leaves evenly spread, chartaceous to subcoriaceous; apex caudate (over 1 cm). Inflorescence branches rather slender 5. *M. rostrata*
8. Flowers basically 5-merous.
11. Leaves abruptly cuspidate (over 1 cm); nerves arcuate, clearly impressed above. Inflorescence raceme-like, seldom branched more than twice. Petals densely silky outside. Branchlets slender. Fruit oblong, $1\frac{1}{2}$ -2 by 0.8-1 cm 9. *M. cuspidata*
11. Leaves other than abruptly cuspidate; nerves not arcuate but mostly sharply prominent, veins mostly distinct. Inflorescence usually branched twice or more, not terminating into a dichasium. Petals glabrous to appressed hairy. Fruit ovoid to oblong, $2\frac{1}{4}$ - $3\frac{1}{2}$ by $1-1\frac{1}{4}$ cm 10. *M. pentandra*

1. Subgenus *Manglesia*

MATTHEW, *Blumea* 23 (1976) 64, f. 1 (map) & 2.

Branchlets and leaves decussate. Stamens 8, in 2 whorls. Inflorescence branches 4-angular. Calyx subtruncate. Fruit with swollen septum.

Distr. 2 spp., in NE. India, N. Burma, NW. Thailand, Central Sumatra.

1. *Mastixia octandra* MATTHEW, *Blumea* 23 (1976) 65, f. 3 (map).

Tree up to 25 m; d.b.h. up to 90 cm. Branchlets slender, decussate, terete, glabrous. Leaves decussate, ovate to elliptic, 4-8 by $1\frac{1}{2}$ -3 cm, chartaceous, glabrous; base cuneate; apex acuminate; nerves 6-8 pairs, with intermediary ones; veins distinct on both surfaces; an occasional subcircular domatium at the axil of nerves; petiole $1-1\frac{1}{2}$ cm, slender. Inflorescence up to 15 cm, slender, glabrous, branched up to 5 times; branches of the first order decussate; pedicels of lateral flowers of terminal cymes over 5 mm, slender. Bracts ovate,

under 3 mm, glabrous. Submature flower bud 3 mm \varnothing . Calyx subtruncate, thin; teeth 4, minute, acute, thin. Petals 4, thick, glabrous outside. Stamens 8. Ovary glabrous. Fruit turbinate, 1 cm. Distr. *Malesia*: West Central Sumatra, once found.

Ecol. Mountain forest, 1700-1800 m.

Notes. Easily distinguished from the continental Asian *M. euonymoides* PRAIN by smaller, chartaceous leaves, suborbicular domatia, more slender, lax and elongate inflorescence parts, the thin calyx with acute teeth, and the generally pedicelled middle flower of the cymes.

2. Subgenus *Mastixia*

Cf. MATTHEW, *Blumea* 23 (1976) 66, f. 1 (map) & 2. — *Mastixia subg. Tetramastixia et Pentamastixia* WANGERIN, Pfl. Reich Heft 414 (1910) 21, 25.

Branchlets and leaves scattered or (sub)opposite. Stamens 4-5(-6), in one whorl. Inflorescence branches terete. Calyx lobed. Septum of the fruit wedge-shaped.

Distr. 11 spp., covering the entire range of the genus.

1. Series *Oppositae*

MATTHEW, *Blumea* 23 (1976) 66.

Inflorescence branches of the first order (sub)opposite or decussate. Branchlets and leaves ditto; nodes flattened. Fruit usually ovoid.

Distr. Throughout *Malesia*, in continental Asia only in Insular Thailand.

2. *Mastixia kaniensis* MELCH. Bot. Jahrb. 60 (1925) 172; DANSER, *Blumea* 1 (1934) 52. — *M.*

ledermannii MELCH. Bot. Jahrb. 60 (1925) 173. — *M. pentandra* (non BL.) DANSER, *Blumea* 1 (1934) 50, p.p.; MATTHEW, *Blumea* 23 (1976) 67. — Fig. 1, 3a-b (galls).

Tree up to 31 m; d.b.h. up to 75(-90) cm. Branchlets stout or slender, (sub)opposite, subglabrous to velutinous. Leaves (sub)opposite, elliptic, obovate, oblong or oblanceolate, ($3\frac{1}{2}$ -) $4\frac{1}{2}$ -18 by 2-8 cm, chartaceous to thick coriaceous, subglabrous, rarely densely velutinous; base attenuate to truncate; apex acuminate to caudate;

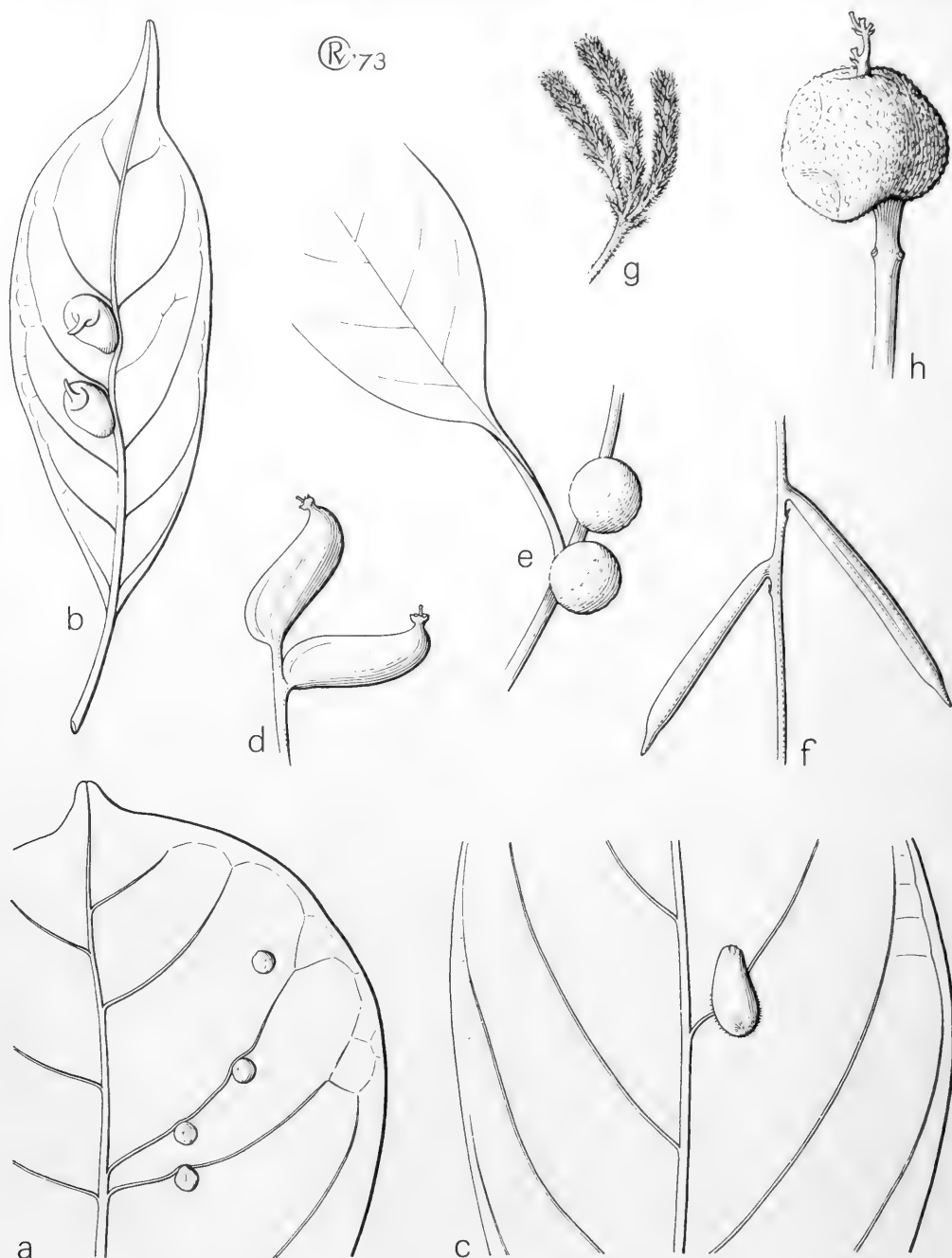


Fig. 3. Galls of *Mastixia*. a. *M. kaniensis* MELCH. *spp. ledermannii* (MELCH.) MATTHEW, b. *M. kaniensis* MELCH. *ssp. kaniensis*, c. *M. pentandra* BL. *ssp. chinensis* (MERR.) MATTHEW, d-e. *M. pentandra* BL. *ssp. philippinensis* (WANGERIN) MATTHEW, f. *M. rostrata* BL. *ssp. caudatifolia* (MERR.) MATTHEW, g. *M. trichotoma* BL. var. *korthalsiana* (WANGERIN) DANSER, h. *M. trichotoma* BL. var. *rhynchocarpa* DANSER. All nat. size, except g $\times 2$ (a CLEMENS 5361, b SCHLECHTER 17703, c LACE 5641, d WENZEL 1150, e FB 2201, f KOSTERMANS 12573, g KOSTERMANS 7316, h KOSTERMANS 7620).

nerves 3-9(-11) pairs, sometimes arcuate; veins usually obscure; petiole 1-2(-4) cm, stout or slender. *Inflorescence* up to 8 cm, stout or slender, subglabrous to puberulous, branched up to 3(-4) times, at times terminating in a dichasium, branches of the first order (sub)opposite. Bracts triangular to lanceolate, up to 4 mm, puberulous to velutinous. Submature flower bud $1\frac{1}{2}$ -2 $\frac{1}{2}$ mm \varnothing . *Sepals* (4-)5(-6-7), broader than long. *Petals* (4-)5(-6), thick or thin, glabrous or puberulous outside. *Stamens* (4-)5(-6). *Ovary* sparsely puberulous. *Fruit* ovoid to oblong, $1\frac{1}{2}$ -2 $\frac{1}{2}$ by 1-1 $\frac{1}{2}$ cm, dull or shining when dry; persistent disk inconspicuous to prominent; sepals inconspicuous.

Distr. *Malesia*: Moluccas, New Guinea, New Britain, and the Solomon Islands. Fig. 4.

Note. Two replacing subspecies are distinguished. The maximum degree of fluctuation in the number of flower parts occurs in the New Guinea—Solomons area.

KEY TO THE SUBSPECIES

1. Leaves chartaceous to subcoriaceous; branchlets and inflorescence axes slender; petals thin, glabrous outside. a. *ssp. kaniensis*
1. Leaves thin- to thick-coriaceous; branchlets and inflorescence axes usually stout; petals thick, puberulous outside. b. *ssp. ledermannii*

a. *ssp. kaniensis*. — Fig. 1, 3b (galls).

Branchlets slender, subglabrous to velutinous. leaves (3 $\frac{1}{2}$)-4 $\frac{1}{2}$ -14 $\frac{1}{2}$ by 2-6 cm, chartaceous to subcoriaceous; base attenuate to cuneate; nerves 3-7 pairs, sometimes arcuate, prominent below; petiole 1-2 cm. *Inflorescence* up to 6 cm, slender, branched 2(-3) times, lax. Flowers relatively small. Bracts triangular to lanceolate, under 3 mm. Submature bud $1\frac{1}{2}$ mm \varnothing . *Petals* (4-)5, relatively

thin, glabrous outside. *Stamens* (4-)5. *Fruit* ovoid to oblong, 2-2 $\frac{1}{2}$ by 1 $\frac{1}{4}$ -1 $\frac{1}{2}$ cm.

Distr. *Malesia*: East New Guinea, New Britain, and Solomon Islands. Fig. 4.

Ecol. Common in primary forests from low altitude up to 1200 m. *Fl. fr.* Jan.-Dec. Leaf- and fruit-galls occur.

Note. Occasional specimens in New Guinea are densely velutinous, others are less so. The basal branches of the inflorescence of the first order are at times subtended by foliage leaves.

b. *ssp. ledermannii* (MELCH.) MATTHEW, *Blumea* 23 (1976) 67. — *M. ledermannii* MELCH. — Fig. 3a (galls).

Branchlets stout, often rusty puberulous when young, subglabrous later. Leaves 6-18 by 2 $\frac{1}{2}$ -8 cm, thin- to thick-coriaceous; base attenuate to truncate; nerves 3-9(-11) pairs, sometimes arcuate, obscure to prominent below; petiole 1 $\frac{1}{2}$ -2(-4) cm. *Inflorescence* up to 8 cm, stout, branched 3(-4) times, compact. Flowers relatively large. Bracts lanceolate below, up to 4 mm. Submature flower bud 2 $\frac{1}{2}$ mm \varnothing . *Petals* (4-)5(-6), thick, puberulous outside. *Stamens* (4-)5(-6). *Fruit* ovoid, $1\frac{1}{2}$ -2 $\frac{1}{2}$ by 1-1 $\frac{1}{4}$ cm.

Distr. *Malesia*: Moluccas and New Guinea. Fig. 4.

Ecol. Primary and secondary forests, 100-1800 m. *Fl. fr.* Jan.-Dec. Leaf-galls occur.

Vern. New Guinea: *bie*, *bon*, Muju, *labakobilien*, Mooi, *masjiw*, Wandammen, *samuwin*, Biak.

Notes. In some specimens a dense indumentum is found.

Though the two subspecies are clearly replacing, some specimens of *ssp. ledermannii* occur in the area occupied by *ssp. kaniensis*, but at higher altitude than *ssp. kaniensis* in this area.

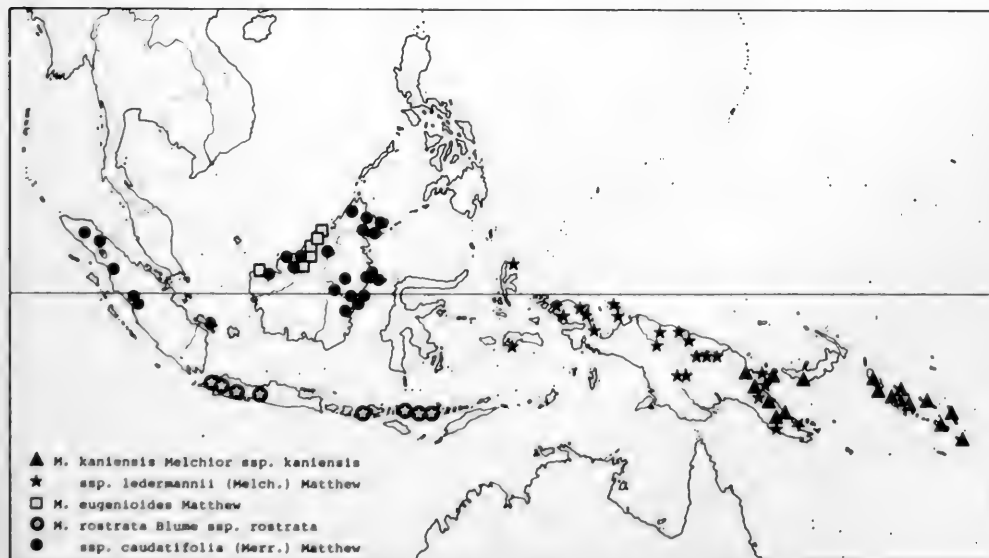


Fig. 4. Localities of three species and two subspecies of *Mastixia*.

3. *Mastixia trichotoma* BL. Bijdr. (1826) 655; DC. Prod. 4 (1830) 275; BL. Mus. Bot. 1 (1850) 257, f. 58; MIQ. Fl. Ind. Bat. 1, 1 (1856) 772, incl. var. *laxa* MIQ. l.c.; K. & V. Bijdr. 5 (1900) 90; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 24, f. 1A-E; KOORD. Atlas 1 (1913) t. 190; Fl. Tjib. 2 (1923); DANSER, Blumea 1 (1934) 57, incl. var. *tenuis*, *acuminatissima*, *clarkeana*, *korthalsiana*, *maingayi*, *benculuana*, *rhynchocarpa* et *simalurana* DANSER, l.c. 61-65; BACK. & BAKH. f. Fl. Java 2 (1965) 159; MEIJER, Bot. News Bull. Sandakan 8 (1967) 65; *ibid.* 10 (1968) 179, illus.; MATTHEW, Blumea 23 (1976) 68. — *M. laxa* BL. Mus. Bot. 1 (1850) 257, incl. var. *angustifolia* BL. l.c.; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 24. — *M. acuminatissima* BL. Mus. Bot. 1 (1850) 258; MIQ. Fl. Ind. Bat. 1, 1 (1856) 772, (1858) 1095; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 22, f. 1F. — *M. caesia* BL. Mus. Bot. 1 (1850) 258. — *M. kimanilla* BL. l.c. 258; MIQ. Fl. Ind. Bat. 1, 1 (1856) 772, (1858) 1095, incl. var. *caesia* MIQ. l.c. 772; K. & V. Bijdr. 5 (1910) 94; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 25. — *M. maingayi* CLARKE, Fl. Br. Ind. 2 (1879) 746; KING, J. As. Soc. Beng. 71, ii (1902) 74, incl. var. *subtomentosa* KING, l.c. 75; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 22. — *M. junghuhniana* (non MIQ.) CLARKE, Fl. Br. Ind. 2 (1879) 746. — *M. clarkeana* KING, J. As. Soc. Beng. 71, ii (1902) 75 & var. *macrophylla* KING, l.c.; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 24; HALL. f. Beih. Bot. Centralbl. 34, 2 (1916) 40. — *M. korthalsiana* WANGERIN in Fedde, Rep. 4 (1907) 335, incl. var. *macrophylla* WANGERIN, l.c. 336 et Pfl. Reich Heft 41⁴ (1910) 25, 26; HALL. f. Beih. Bot. Centralbl. 34, 2 (1916) 40. — *M. propinqua* RIDL. J. Fed. Mal. St. Mus. 4, 1 (1909) 25; Fl. Mal. Pen. 1 (1922) 890. — *Vitex premmoides* ELMER, Leaf. Philip. Bot. 8 (1915) 2874. — *M. premmoides* HALL. f. Beih. Bot. Centralbl. 34, 2 (1916) 41; MERR. Philip. J. Sc. 13 (1918) 43; En. Philip. 3 (1923) 242. — *M. rostrata* (non BL.) RIDL. Fl. Mal. Pen. 1 (1922) 890. — Fig. 3g-h (galls).

Tree up to 40 m; d.b.h. up to 50(-150) cm; branchlets stout or slender, opposite, puberulous to woolly. Leaves opposite, ovate, elliptic to oblong, 5-24(-28) by 2-12 cm, thin to thick-coriateous, subglabrous to villous below; base cuneate, obtuse or attenuate; apex acute to acuminate; nerves 5-15 pairs, impressed above, prominent to prominent below, at times arcuate; veins prominent to prominent below; petiole $1\frac{1}{4}$ - $2\frac{1}{2}$ (-3 $\frac{1}{2}$) cm, stout or slender. Inflorescence up to 15 cm, stout or slender, compact or lax, puberulous to woolly; branched up to 5 (or 6) times; branches of the first order opposite; higher order bracts triangular, more or less connate, villous to woolly; lower bracts lanceolate, up to 10 mm, villous to woolly. Submature flower bud 2-3 $\frac{1}{2}$ mm \varnothing . Sepals 4 or 5, as long as wide, thick, puberulous to villous. Petals 4 or 5, thick, puberulous to villous outside. Stamens 4 or 5. Ovary puberulous to villous. Fruit ovoid to elongate, acute, $1\frac{1}{2}$ -3 $\frac{1}{4}$ by $\frac{1}{2}$ -2 cm; persistent disk inconspicuous to prominent; sepals prominent.

Distr. Peninsular Thailand and throughout Malesia, except New Guinea. Fig. 5.

Notes. DANSER (l.c. 59-61) adequately discussed variations within the species; most of the vernacular names he listed (l.c. 72-73) belong to the present species.

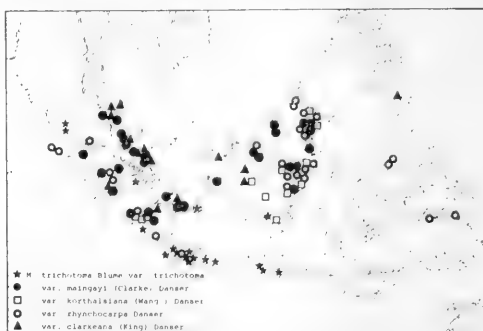


Fig. 5. Localities of *Mastixia trichotoma* BL. and its varieties.

Figure 1 of WANGERIN (l.c. 23) is rather schematic. The position of ovule attachment and the length of the sepals are inaccurately drawn.

KEY TO THE VARIETIES

1. Inflorescence villous to woolly.
 2. Twigs woolly. Leaves 9-20 cm long, thick-coriateous, villous to woolly; nerves often arcuate; base obtuse to truncate. Fruit ovoid, more than $1\frac{1}{2}$ cm \varnothing c. var. *maingayi*
 2. Twigs not woolly. Leaves 5-15 cm long, chartaceous to subcoriateous, subglabrous to puberulous; nerves seldom arcuate; base attenuate to cuneate. Fruit elongate-ovoid, up to $1\frac{1}{2}$ cm \varnothing .
3. Inflorescence compact. Sepals, petals, and stamens 4. a. var. *trichotoma*
3. Inflorescence very lax. Sepals, petals, and stamens 5. b. var. *korthalsiana*
1. Inflorescence subglabrous to puberulous.
 4. Fruit with prominent persistent disk, over $2\frac{1}{2}$ by $1\frac{1}{2}$ cm. Leaves 10-24 by 5-12 cm. Inflorescence robust, up to 15 cm, branched 5 (to 6) times, not terminating in a dichasium.
 - d. var. *rhynchocarpa*
 4. Fruit without prominent persistent disk, up to 2 by 1 cm. Leaves usually 5-12 by 2-4 $\frac{1}{2}$ cm. Inflorescence slender, up to 10 cm, branched 3(-4) times, often terminating in a dichasium.
 - e. var. *clarkeana*

a. var. *trichotoma* — *M. laxa* BL. — *M. trichotoma* BL. var. *laxa* MIQ. — *M. laxa* BL. var. *angustifolia* BL. — *M. acuminatissima* BL. — *M. trichotoma* BL. var. *acuminatissima* DANSER — *M. caesia* BL. — *M. kimanilla* BL. incl. var. *caesia* MIQ.

Branchlets rather slender, yellowish, puberulous to velutinous. Leaves elliptic to oblong, 5-15 by 3-8 cm, chartaceous to subcoriateous, subglabrous to puberulous; base cuneate to attenuate; apex acute to acuminate; nerves 5-8 pairs, prominent to prominent below, seldom arcuate; petiole $1\frac{1}{4}$ -2(- $2\frac{1}{2}$) cm, rather slender. Inflorescence up to 8 cm, compact, branched 3(-4) times, villous to woolly; basal bracts under 5 mm; terminal bracts often deeply boat-shaped. Sepals 4. Petals 4. Stamens 4. Fruit elongate-ovoid, $1\frac{1}{2}$ -3 by

1-1½ cm; persistent disk inconspicuous; sepals prominent.

Distr. *Malesia*: N. Sumatra, W.-E. Java, Borneo, Lesser Sunda Is. (Bali). Fig. 5.

Ecol. In primary forest from low altitude up to 1800 m. *Fl.* May-Jan., *fr.* July-March. Galls occur on stem and fruit.

Vern. Java: *djērēt*, *huru hiris*, *h. minjak*, *kēndu*, *kibēntēli*, *kibunting*, *kidēdak*, *kilumlum*, *kilun glum*, *kimēnjan*, *kitēnjo*, (*huru*) *mēhmal*, *mēmah*, *palaglar minjak*, *tēnggau*, *tēnju*.

b. var. korthalsiana (WANGERIN) DANSER, *Blumea* 1 (1934) 63; MATTHEW, *Blumea* 23 (1976) 70. — *M. korthalsiana* WANGERIN. — Fig. 3g (galls).

Branchlets rather slender, yellowish, subglabrous to velutinous. Leaves subovate-elliptic, 10-12 by 3-5 cm, subcoriaceous; base long attenuate; apex acuminate; nerves 5-6 pairs, seldom arcuate; petiole 1¼-1¾ cm, rather slender. Inflorescence up to 10 cm, very lax, branched 3(-4) times, few-flowered, velutinous to woolly; bracts under 3 mm. Sepals 5. Petals 5. Stamens 5. Fruit elongate-ovoid, 2½-3 by 1-1½ cm, persistent disk inconspicuous, sepals prominent.

Distr. *Malesia*: Sumatra, Borneo. Fig. 5.

Ecol. In primary forest from low altitude up to 640 m, often scattered. Rather prone to galls.

Vern. Sumatra: *mēdang kladi*. E. Borneo: *sērgam pipit*, *Sangkulirang* I.

Note. The lax and few flowered inflorescence, the 5-merous flowers, and elongate fruit distinguish this variety from *var. trichotoma* to which it is closely allied.

c. var. maingayi (CLARKE) DANSER, *Blumea* 1 (1934) 63; MATTHEW, *Blumea* 23 (1976) 70. — *M. maingayi* CLARKE, *incl. var. subtomentosa* KING — *M. junghuhniana* (non MIQ.) CLARKE — *M. rostrata* (non BL.) RIDL. — *M. propinqua* RIDL.

Branchlets very stout, yellowish, woolly. Leaves ovate to elliptic, 9-20 by 4-11 cm, thick coriaceous, tough and stiff; base obtuse to truncate; apex acute to acuminate; nerves 5-6 pairs, deeply impressed above, very prominent below, often arcuate, numerous parallel intermediary veins conspicuous; petiole 1½-2½ cm, stout, villous to woolly. Inflorescence up to 15 cm, compact, branched 4(-5) times, velutinous to golden woolly; basal bracts up to 1 cm, persistent. Sepals 4. Petals 4. Stamens 4. Fruit ovoid, 2½-3½ by 1½-2 cm; persistent disk inconspicuous, sepals prominent.

Distr. *Malesia*: Sumatra, Malay Peninsula (also Penang), Banka, Borneo. Fig. 5.

Ecol. In primary forests with Dipterocarps; also in secondary or marsh forests, from the lowland to 1400 m. *Fl.* Febr.-Aug. (Nov.), *fr.* April-Dec. Galls occur on leaves and fruit.

Vern. Malaya: *karu nuri*, *kayu bēngkal bukit*, *kayu maura*, *mēdang*. Banka: *mēdang puntung*, *m. pusēr*. Borneo: *mēdang kanigara*.

Note. Easily recognized by the woolly indumentum, large and stiff leaves with prominent veins, and the numerous massive fruits.

d. var. rhynchocarpa DANSER, *Blumea* 1 (1934) 64; MATTHEW, *Blumea* 23 (1976) 71. — *M. trichotoma* BL. *var. benculuana* et *var. simalurana* DANSER. — Fig. 3h (galls).

Branchlets stout, dark, subglabrous. Leaves elliptic to oblong, 10-24(-28) by 5-12 cm, coriaceous, tough and stiff; base cuneate to obtuse; apex acute, acuminate to caudate; nerves 8-15 pairs, very prominent below, seldom arcuate; petiole 1½-2½(-3½) cm, stout. Inflorescence up to 15 cm, compact, profusely branched up to 5(-8) times, not terminating in a dichasium, subglabrous to puberulous; basal bracts up to 5 mm. Sepals 4(-5). Petals 4. Stamens 4. Fruit ovoid to elongate-ovoid, 2½-3½ by 1½-2 cm; persistent disk prominent, bulging; sepals prominent.

Distr. *Malesia*: Sumatra (incl. Simalur I.), W. Java, Borneo, NE. Celebes, Moluccas (Ambon, Ceram). Fig. 5.

Ecol. Common in primary lowland and mossy forest, up to 1800 m. *Fl.* April-Aug., *fr.* June-March.

Galls. This variety is very prone to fruit galls and the largest ones in the genus (over 1½ cm Ø) occur here.

Vern. Sumatra: *ahēlāt*, *awa ahēlat uding*, *awa ēnti*, *awa simangurach*, *tutun simangurah*, Simalur I.; *bung*, *mēdang tima*, *tanah*, Bencoolen. Borneo: *mēdang aimā*. Moluccas: *soya*.

Note. This variety is noted for the generally large dimensions of leaves and inflorescence, though there is a reduction in size from Borneo to Moluccas.

e. var. clarkeana (KING) DANSER, *Blumea* 1 (1934) 62; MATTHEW, *Blumea* 23 (1976) 72. — *M. clarkeana* KING, *incl. var. macrophylla* KING — *M. korthalsiana* WANGERIN *var. macrophylla* WANGERIN — *Vitex premnoides* ELMER — *M. premnoides* HALL. *f.* — *M. trichotoma* BL. *var. tenuis* DANSER.

Branchlets slender, grey, subglabrous. Leaves oblong to elliptic-oblong, 5-12(-18) by 2-4(-8½) cm, coriaceous; base cuneate to obtuse; apex acute to acuminate; nerves 5-7 pairs, seldom arcuate; petiole 1-1½ cm, slender. Inflorescence up to 10 cm, compact, branched 3(-4) times, often terminating in a dichasium. Sepals 4. Petals 4. Stamens 4. Fruit ovoid, 1½-2 by ½-1 cm; persistent disk inconspicuous; sepals prominent.

Distr. Peninsular Thailand (Pattani) and *Malesia*: Sumatra, Banka, Malay Peninsula, Borneo, Philippines (Mindanao). Fig. 5.

Ecol. Primary forest, from low altitude to 1100 m. *Fl.* Jan.-Aug., *fr.* July-Febr. Galls occur on stem and fruit.

Vern. Philippines: *lamog*.

4. Mastixia eugenioides MATTHEW, *Blumea* 23 (1976) 73.

Tree up to 30 m; d.b.h. up to 30 cm; branchlets stout, opposite, glabrous. Leaves opposite, elliptic to oblong-elliptic, 4-12 by 2-5½ cm, thick-coriaceous, glabrous; base cuneate; apex acuminate to caudate; nerves 5-7 pairs, prominent beneath, with intermediary ones and distinct veins; petiole 1½-2½ cm, stout. Inflorescence up to 8 cm, rather stout and compact, glabrous, up to 4 times branched, at times terminating in a dichasium; branches of the first order opposite; higher order bracts triangular, under 3 mm; lower bracts lanceolate, up to 5 mm, all glabrous. Submature flower bud 2 mm Ø. Sepals 4, broader than long,

thick, glabrous. *Petals* 4, thin, glabrous outside. *Stamens* 4. *Ovary* glabrous. *Fruit* (unripe) ovoid, 2½ by 1½ cm; persistent disk and sepals inconspicuous.

Distr. *Malesia*: Borneo (Sarawak, Brunei). Fig. 4.

Ecol. Primary (often Dipterocarp) lowland forests, up to 400 m. *Fl.* July–Aug., *fr.* Sept.

Notes. Leaf scars conspicuous; inflorescence notably erecto-patent when young, spreading later. The inflorescence and flowers somewhat resemble those of *M. rostrata* ssp. *rostrata*, but the stout branchlets with strictly opposite leaves and stout petiole, prominent intermediary veins, and fruits of different shape with thick pericarp, make this species quite distinct.

All the 9 collections are from a restricted area.

5. *Mastixia rostrata* BL. Mus. Bot. 1 (1850) 258; MIQ. Fl. Ind. Bat. 1, 1 (1856) 773, (1858) 1095; K. & V. Bijdr. 5 (1900) 92; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 22; KOORD. Atlas 1 (1913) t. 191; DANSER, Blumea 1 (1934) 52; BURK. Dict. (1935) 1428; DOCT.V. LEEUWEN, Ned. Kruidk. Arch. 51 (1941) 207; BACK. & BAKH. f. Fl. Java 2 (1965) 159; MEIJER, Bot. News Bull. Sandakan 8 (1976) 65; MATTHEW, Blumea 23 (1976) 73. — *M. junghuhniana* MIQ. Fl. Ind. Bat. 1, 1 (1856) 772. — *M. margarethae* WANGERIN in Fedde, Rep. 4 (1907) 335; Pfl. Reich Heft 41⁴ (1910) 21. — *M. cuspidata* BL. var. *margarethae* HALL. f. Beih. Bot. Centralbl. 34, 2 (1916) 41. — *M. caudatifolia* MERR. Pl. Elm. Born. (1929) 233.

Tree up to 30 m; d.b.h. up to 50 cm; branchlets slender, (sub)opposite or scattered, glabrous. *Leaves* (sub)opposite or scattered, elliptic to oblong-elliptic, 4–10 by 2–5 cm, chartaceous to subcoriaceous, glabrous; base cuneate; apex caudate over 1 cm; nerves 4–6 pairs, prominent below; veins obscure; petiole 1–2½ cm, slender. *Inflorescence* up to 6 cm, slender, compact or lax, subglabrous, up to 4 times branched, branches of the first order (sub)opposite or scattered; bracts triangular, under 3 mm, glabrous. Submature flower bud 1–2½ mm Ø. *Sepals* 4, broader than long, thin, glabrous. *Petals* 4, glabrous outside. *Stamens* 4. *Ovary* glabrous. *Fruit* ovoid to oblong, 1½–3 by ¾–1 cm, persistent disk prominent or inconspicuous, sepals inconspicuous.

Distr. *Malesia*: Sumatra, Banka, Java, Borneo, Lesser Sunda Is. (Sumbawa, Flores). Fig. 4.

KEY TO THE SUBSPECIES

1. Submature flower bud 2½ mm Ø. Inflorescence compact, branches of the first order (sub)opposite. Leaves (sub)opposite. Galls absent
a. ssp. *rostrata*
1. Submature flower bud 1 mm Ø. Inflorescence lax, branches of the first order scattered. Leaves scattered. Galls frequent. b. ssp. *caudatifolia*

a. ssp. *rostrata* — *M. junghuhniana* MIQ.

Branchlets (sub)opposite. Leaves (sub)opposite, less often scattered; petiole 1½–2 cm. Inflorescence compact, generally under 4 cm, glabrous; primary branches (sub)opposite. Submature flower bud 2½ mm Ø.

Distr. *Malesia*: West & Central Java, Lesser Sunda Is. (Sumbawa, Flores). Fig. 4.

Ecol. Moist forest, from low altitude up to 1400 m. *Fl.* March, very fragrant, *fr.* May–July. Galls absent. Ripe fruit dark blue.

Vern. Java: *daun kaju tendjo*, *daun kitadjas*, *huru gading*, *kilburoy*, *kilèjas*, *kitèndjo*, *kitindjo*, *lalakina*, *tjangkar*. Flores: *bumis*, *rau*, *tapaëke*.

Notes. Specimens from the Lesser Sunda Is. have larger leaves than those from Java.

The reference in KANJILAL & DAS (Fl. Assam 2, 1938, 371) to this species seems erroneous, as it does not occur on the Asian continent. If the statement “stamens 3” is correct, the plant can even not belong to *Mastixia*.

b. ssp. *caudatifolia* (MERR.) MATTHEW, Blumea 23 (1976) 74. — *M. margarethae* WANGERIN — *M. caudatifolia* MERR. — Fig. 3f (galls).

Branchlets scattered. Leaves scattered; petiole up to 1½ cm. Inflorescence very lax, up to 6 cm, puberulous at the nodes; primary branches scattered. Submature flower bud 1 mm Ø.

Distr. *Malesia*: northern half of Sumatra, Banka, Borneo. Fig. 4.

Ecol. Primary forest, from the lowland up to 1600 m. *Fl.* June–Oct., *fr.* Aug.–March. Globose to elongate galls are common, specially those on fruits. Sometimes they resemble a legume and can be up to 3½ cm long.

Vern. Borneo: *patoli entelit*, Iban lang.

Note. It is almost impossible to separate sterile materials of ssp. *caudatifolia* from those of *M. cuspidata*, though their flowers are entirely different.

2. Series *Alternae*

MATTHEW, Blumea 23 (1976) 75.

Inflorescence branches of the first order scattered; branchlets and leaves scattered; nodes terete; fruit generally ellipsoid or oblong.

Distr. Ceylon and continental Asia; through *Malesia*, but absent in New Guinea and Solomon Is.

6. *Mastixia macrocarpa* MATTHEW, Blumea 23 (1976) 75.

Tree up to 21 m; d.b.h. up to 20 cm; branchlets stout, scattered, woolly. *Leaves* scattered, elliptic-oblong to oblong, 13–30 by 5½–15 cm, subcoriaceous, villous, especially below; base cuneate, at times slightly oblique; apex acuminate; nerves 7–10 pairs, prominent below, villous; veins prominent, puberulous to villous; petiole 4–7 cm, stout, woolly. *Inflorescence* up to 9 cm, stout, woolly, branched up to 4 times; branches of the first order scattered; bracts triangular to lanceolate, up to 8 mm, densely woolly. Submature flower bud 4 mm Ø. *Sepals* 5, broader than long, villous. *Petals* 5, velvety outside. *Stamens* 5. *Ovary* densely villous. *Fruit* oblong-ovoid, 4–4½ by 2 cm; persistent disk inconspicuous, sepals prominent, up to 5 mm.

Distr. *Malesia*: Borneo (Sarawak), Philippines (Luzon); 2 collections. Fig. 6.

Ecol. Lowland forest. *Fl.* Oct., *fr.* June. Sticky resin on the branches; fruits very pale green.

Note. Leaves and fruits are the largest known in the genus; lenticels up to 3 by 1 mm; leaf scars up

to 4 by 4 mm; peduncles of terminal cymes up to 6 mm; pedicels 2 mm; sepals 2 mm broad at the base; filaments 3 mm; anthers $1\frac{1}{2}$ mm; receptacle $3-3\frac{1}{2}$ by 2 mm; style 4 mm; stigma 5-lobed, appearing bifid.

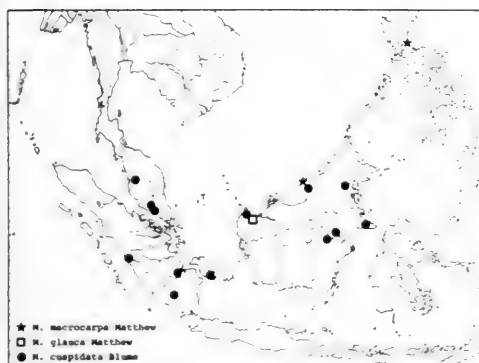


Fig. 6. Localities of three species of *Mastixia*.

7. *Mastixia glauca* MATTHEW, Blumea 23 (1976) 76.

Tree up to 15 m; branchlets stout, scattered, glabrous. *Leaves* scattered, obovate, 7–16 by $4\frac{1}{2}-8\frac{1}{2}$ cm, thick-coriaceous, glaucous and waxy below, glabrous; base obtuse; apex apiculate; nerves 4–5 pairs, with intermediary ones, all obscure; veins obscure; petiole $2-3\frac{1}{2}$ cm, stout, glabrous. *Inflorescence* up to 5 cm, rather stout and compact, subglabrous to sparsely puberulous, branched up to 5 times; branches of the first order scattered; bracts triangular, under 3 mm. Submature flower bud 3 mm \varnothing . *Sepals* 4(–5), as long as broad, sparsely puberulous. *Petals* 4(–5), thick, appressed-hairy outside. *Stamens* 4(–5). *Ovary* sparsely puberulous.

Distr. Malesia: Borneo (Sarawak: Mt Santu-bong), 3 collections Fig. 6.

Ecol. Lowland forest. *Fl.* April–May.

Note. Tender bark of branchlets yellowish; inflorescence clearly broader than long; 5-merous flowers only occasional.

8. *Mastixia tetrapetala* MERR. Philip. J. Sc. 13 (1918) Bot. 42; En. Philip. 3 (1923) 242; MATTHEW, Blumea 23 (1976) 76, f. 5 (map). — *M. pachyphylla* MERR. Philip. J. Sc. 13 (1918) Bot. 325; En. Philip. 3 (1923) 241. — *M. crassifolia* MERR. Philip. J. Sc. 26 (1925) 486.

Tree up to 8(–15) m; branchlets very stout, scattered to subopposite, subglabrous. *Leaves* scattered to subopposite, crowded at apices of branchlets, obovate to oblanceolate, 5–15 by 2–7 cm, thick coriaceous, glabrous; base cuneate; apex acute to acuminate; nerves 6–8(–12) pairs, usually prominent below; veins prominulous below; petiole $1-2\frac{1}{2}$ cm, stout, glabrous. *Inflorescence* up to 3(–6) cm, stout, very compact, puberulous to villous, 2(–3) times branched; branches of the first order scattered; higher order bracts triangular, under 3 mm; lower ones lanceolate up to 5 mm, puberulous. Submature flower

bud 5 mm \varnothing . *Sepals* 4, broader than long, glabrous to appressed-hairy. *Petals* 4, thick, glabrous to appressed-hairy. *Stamens* 4. *Ovary* glabrous to appressed-hairy. *Fruit* ellipsoid, 2–3 by $1\frac{1}{4}-1\frac{1}{2}$ cm; persistent disk and sepals inconspicuous.

Distr. Malesia: Philippines (Luzon, Catanduanes), 7 collections.

Ecol. Primary forest, from low altitude up to 2300 m. *Fl.* Febr.–March, *fr.* Sept.–Febr.

Notes. Branchlets stout with conspicuous leaf scars and fibrous bark. Phyllotaxis tends to be obscured owing to congestion of parts: leaves are generally crowded towards the apices of branchlets. Inflorescence branches do not always elongate as in other species.

The species is quite distinct and stands rather isolated from others in the stoutness of parts, the large, 4-merous flowers, and the large, ellipsoid fruits.

Two other species of MERRILL, *M. pachyphylla* and *M. crassifolia* are considered conspecific with *M. tetrapetala*. There are indeed certain differences: leaves of *M. crassifolia* generally have 8–12 nerves per side prominent below, and massive fruits. *M. pachyphylla* has (sub)opposite leaves and primary inflorescence branches. However, when examined together, it is seen that both *M. pachyphylla* and *M. crassifolia* are extreme variations of *M. tetrapetala*.

9. *Mastixia cuspidata* BL. Mus. Bot. 1 (1850) 256; MIQ. Fl. Ind. Bat. 1, 1 (1856) 772; HALL. f. Beih. Bot. Centralbl. 34, 2 (1916) 41; DANSER, Blumea 1 (1934) 55, excl. var. *margarethae*; MATTHEW, Blumea 23 (1976) 79. — *M. pentandra* BL. var. *cuspidata* MIQ. Fl. Ind. Bat. 1, 1 (1858) 1095; WANGERIN, Pfl. Reich Heft 41^a (1910) 26. — *M. bracteata* CLARKE, Fl. Br. Ind. 2 (1879) 746; KING, J. As. Soc. Beng. 71, ii (1902) 73; WANGERIN, Pfl. Reich Heft 41^a (1910) 26, f. 1 G-K, N-O; DANSER, Blumea 1 (1934) 54.

Tree up to 24 m; d.b.h. up to 40 cm; branchlets very slender, scattered, subglabrous. *Leaves* scattered, obovate, elliptic or oblong, 4–12(–16) by 2–4(–6) cm, subcoriaceous, glabrous; base cuneate; apex abruptly cuspidate (over 1 cm), oblique; nerves 4 (or 5) pairs, arcuate, impressed above; veins obscure; petiole $1-1\frac{1}{4}$ cm, slender. *Inflorescence* up to 4 cm, rather slender, subglabrous to puberulous, 2(–3) times branched; branches of the first order scattered; higher order bracts subulate, lower ones foliaceous, over 10 mm, passing into foliage leaves. Submature flower bud 3 mm \varnothing . *Sepals* 5, broader than long, subglabrous. *Petals* 5, thick, densely appressed-hairy outside. *Stamens* 5. *Ovary* densely appressed silky-hairy. *Fruit* oblong, $1\frac{1}{2}-2$ by $\frac{3}{4}-1$ cm; persistent disk and sepals inconspicuous.

Distr. Malesia: Sumatra, Banka, Malay Peninsula, Borneo. Fig. 6.

Ecol. Primary and secondary forests, from low altitude up to 900 m.

Vern. Sumatra: *bëbung*, *kundur*. Banka: *mënkapas*. Malay Peninsula: *dadaru*. Borneo: *biansugunong*, Sarawak.

10. *Mastixia pentandra* BL. Bijdr. (1826) 654; DC. Prod. 4 (1830) 275; BL. Mus. Bot. 1 (1850) 256; MIQ. Fl. Ind. Bat. 1, 1 (1856) 771, (1858) 1095;

K. & V. Bijdr. 5 (1900) 88; MERR. Philip. J. Sc. 1 (1906) Suppl. 111; DANSER, Blumea 1 (1934) 49; BACK. & BAKH. f. Fl. Java 2 (1965) 159; MATTHEW, Blumea 23 (1976) 80, f. 5 (map), 6. — *M. arborea* [non (WIGHT) BEDD.] CLARKE, Fl. Br. Ind. 2 (1879) 745, p.p.; KANJILAL & DAS, Fl. Assam 2 (1938) 370; HUNDLEY & CHIT, Trees Shr. Burma ed. 3 (1961) 119. — *M. cambodiana* PIERRE, Fl. Coch. (1892) t. 260 B; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 29; ÉVRARD, Fl. Gén. I.-C. 2 (1923) 1195. — *M. scortechinii* KING, J. As. Soc. Beng. 71, ii (1902) 73; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 27, f. 1 L-M; DANSER, Blumea 1 (1934) 56. — *M. philippinensis* WANGERIN in Fedde, Rep. 10 (1912) 273; MERR. En. Philip. 3 (1923) 241; CHAO, Taiwan 5 (1954) 94, 99, f. 37; LI & CHAO, Quart. J. Taiwan Mus. 7 (1954) 124, f. 19. — *M. parvifolia* HALL. f. Beih. Bot. Centralbl. 34, 2 (1916) 41; DANSER, Blumea 1 (1934) 51. — *M. subcaudata* MERR. Philip. J. Sc. 13 (1918) 43; En. Philip. 3 (1923) 242. — *M. megacarpa* RIDL. Fl. Mal. Pen. 1 (1922) 891. — *M. chinensis* MERR. Sunyatsenia 3 (1937) 256; LI, Taiwan 1 (1938) 94. — *M. alternifolia* MERR. & CHUN, Sunyatsenia 5 (1940) 153. — *M. poilanei* TARDIEU, Fl. Camb. Laos & Vietnam 8 (1968) 16. — Fig. 3c-e (galls).

Tree up to 37 m; d.b.h. up to 75 cm; branchlets slender or stout, scattered, subglabrous to puberulous. Leaves scattered, obovate, elliptic to oblong-elliptic, 4–16 by 2–8 cm, chartaceous to thick-coriateous, subglabrous; base cuneate to attenuate; apex acute or acuminate to caudate; nerves 4–7(–9) pairs, distinct below; veins distinct below; petiole stout or slender, 1–4 cm. Inflorescence up to 8 cm, slender or stout, subglabrous to densely appressed-hairy, up to 3(–4) times branched; branches of the first order scattered; bracts either all triangular, under 3 mm, or lower ones lanceolate, up to 15 mm; basal inflorescence axes of the first order subtended by ordinary bracts or by leaves. Submature flower bud up to 3½ mm Ø. Sepals 4 or 5, broader than long or as long as broad, thick, puberulous, to appressed-hairy. Petals 4 or 5, thick, glabrous to appressed-hairy. Stamens 4–5. Ovary puberulous to appressed-hairy. Fruit ovoid to oblong, 2¼–3½ by 1–1¼ cm; persistent disk conspicuous or not; sepals inconspicuous.

Distr. Continental SE. Asia (NE. India, Bhutan, Burma, Thailand, Tonkin, S. Yunnan) and throughout *Malesia*; not yet recorded from the Lesser Sunda Is. and New Guinea.

KEY TO THE SUBSPECIES

1. Flowers basically 4-merous. Inflorescence stout, rusty-puberulous. Corolla glabrous outside. Leaves obovate, coriaceous; apex acute; base attenuate **b. ssp. moluccana**
1. Flowers basically 5-merous.
 2. Leaves up to 8–20 by 4–8 cm; nerves 6 or more pairs; veins distinct beneath. Fruit ovoid.
 3. Basal bracts lanceolate, up to 15 mm. Fruit larger than 3 by 1¼ cm **a. ssp. pentandra**
 3. All bracts triangular, under 3 mm. Fruit up to 2½ by 1 cm **c. ssp. chinensis**
 2. Leaves up to 4–12 by 1½–5 cm; nerves up to 6 pairs; veins obscure beneath. Fruit oblong.

4. Length of sepals up to half as long as wide. Leaves chartaceous to subcoriaceous. Fruit 2½–3 cm long **d. ssp. philippinensis**
4. Length of sepals almost as long as wide. Leaves coriaceous to thick-coriaceous. Bracts uniformly triangular. Fruit 1¾–2 cm long **e. ssp. scortechinii**

a. ssp. pentandra.

Tree up to 34 m; branchlets stout. Leaves elliptic to oblong-elliptic, 8–16 by 4–8 cm, coriaceous; base cuneate; apex acuminate; nerves 6–7(–9) pairs; veins distinct below; petiole stout, 2–4 cm. Inflorescence up to 8 cm, stout, densely appressed-hairy; basal bracts lanceolate, up to 15 mm. Sepals 5, broader than long. Petals 5, appressed-hairy outside. Stamens 5. Fruit ovoid, 3–3½ by 1¼–1½ cm.

Distr. *Malesia*: West & East Java.

Ecol. In humid, mixed forest, 400–500 m. *Fl.* July–Dec.

Vern. Java: *huru lilin, tenjau*.

b. ssp. moluccana MATTHEW, Blumea 23 (1976) 81.

Tree up to 15 m; d.b.h. 20 cm; branchlets stout. Leaves obovate, 8–15 by 3–8 cm, coriaceous; base attenuate; apex acute; nerves 5–6 pairs; veins distinct below; petiole stout, 2½–3 cm. Inflorescence up to 5 cm, stout, rusty puberulous; basal bracts up to 4 mm. Sepals 4(–5), broader than long. Petals 4(–5), glabrous outside. Stamens 4(–5). Fruit (immature) ovoid, 1¼ by ¾ cm.

Distr. *Malesia*: Moluccas (Morotai).

Ecol. Mixed rain-forest, up to 1000 m. *Fl.* May. Once a leaf-gall was noted.

Notes. The basal pair of lateral inflorescence branches often occur in the axils of normal leaves, a tendency noted in *ssp. philippinensis*. Flowers relatively large, yellowish to greenish; corolla dome-shaped (in bud). Calyx margin wavy; petals 4 by 3 mm; filaments 3 mm; anther 1 mm; style 1½ mm. The only fruit seen is detached and immature.

The arrangement of the primary inflorescence branches is at times obscure.

The soft, coriaceous texture of the leaves, dark above, and pale below, the stout inflorescence with rusty indumentum and the few, large, 4-merous flowers with glabrous dome-shaped corolla (in bud) distinguish this subspecies from the others. It is yet only known from Morotai I.

c. ssp. chinensis (MERR.) MATTHEW, Blumea 23 (1976) 83. — *M. chinensis* MERR. — Fig. 3c (galls).

Tree up to 20 m; branchlets stout. Leaves elliptic to elliptic-oblongate, 8–20 by 4–8 cm, coriaceous; base attenuate; apex acute; nerves 6–8 pairs; veins distinct below; petiole stout, 1¾–2½ cm. Inflorescence up to 8 cm, subglabrous to appressed-hairy; all bracts uniform, under 3 mm. Sepals 5, broader than long. Petals 5, appressed-hairy outside. Stamens 5. Fruit oblong, 2–2½ by 1 cm.

Distr. NE. India, Bhutan, N. Burma, Thailand, S. China (Yunnan), Tonkin; in *Malesia*: Malay Peninsula (Kedah, once).

Ecol. Mixed forests up to 1900 m. *Fl.* May–June, *fr.* Aug.–May. In India galls and domatia occur.

d. *ssp. philippinensis* (WANGERIN) MATTHEW, Blumea 23 (1976) 85. — *M. philippinensis* WANGERIN — *M. subcaudata* MERR. — Fig. 3d–e (galls).

Tree up to 22½ m; branchlets slender. Leaves obovate to elliptic, 4–12 by 1½–5 cm, chartaceous to subcoriaceous; base attenuate; apex acuminate; nerves 4–6 pairs; veins obscure beneath; petiole slender, 1–2 cm. Inflorescence up to 7 cm, slender, subglabrous to puberulous; all bracts triangular, under 3 mm. Sepals (4–)5, broader than long. Petals (4–)5, glabrous to appressed-hairy outside. Stamens (4–)5. Fruit oblong, 2½–3 by 1¼–1½ cm.

Distr. *Malesia*: throughout the Philippines.

Ecol. In forests, from low altitude up to 1350 m. Fl. May–Sept., fr. Jan.–Dec. Galls are rather frequent on stem, leaf and fruit.

Note. *Ssp. philippinensis* is distinguished from *ssp. scortechinii* in the generally smaller height and smaller and thinner leaves, more slender inflorescence axis, the lower 1 or 2 inflorescence axis (axes) at the axil(s) of normal leaves, and the oblong fruits.

e. *ssp. scortechinii* (KING) MATTHEW, Blumea 23 (1976) 86. — *M. scortechinii* KING — *M. megacarpa* RIDL. — *M. parvifolia* HALL. f.

Tree up to 37 m; branchlets stout. Leaves obovate to oblong, 4–12(–15) by 3–5(–6) cm, thick-coriaceous; base cuneate to attenuate; apex acute to acuminate; nerves 4–6 pairs; veins obscure beneath; petiole stout, 1½–2½ cm. Inflorescence up to 8 cm, stout, puberulous to villous; all bracts triangular, under 3 mm. Sepals (4–)5, as long as broad. Petals (4–)5. Stamens (4–)5. Fruit oblong, 2¼–2½ by 1¼–2 cm.

Distr. Thailand (once); in *Malesia*: S. Sumatra, Banka, Malay Peninsula, Borneo, Celebes.

Ecol. Primary forests, from low altitude up to

2400 m. Fl. fr. Jan.–Dec. Inflorescences and fruit galls occur.

Vern. Malaya: *médang pisang*. Banka: *mēn-kapas*. Borneo: *kaju wulu*, *médang surugan*.

Note. *Ssp. scortechinii* is distinguished from *ssp. pentandra* by the generally obovate and smaller leaves, less stout inflorescence, uniformly short bracts and oblong fruits with thick pericarp.

Excluded

Mastixia cuneata BL. Mus. Bot. Lugd. Bat. 1 (1850) 257 = *Notaphoebe umbelliflora* (BL.) BL. Cf. HALL. f. Beih. Bot. Centralbl. 34, 2 (1916) 42; DANSER, Blumea 1 (1934) 68.

Mastixia gracilis KING, J. As. Soc. Beng. 74, ii (1902) 73; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 28; DANSER, Blumea 1 (1934) 68; MATTHEW, Blumea 23 (1976) 90 = *Vaccinium bancanum* MIQ. var. *tenuinervium* J. J. S. (*Ericaceae*), according to the type number WRAY 1528 mentioned by SLEUMER, Blumea 11 (1961) 76. — Ed.

Mastixia heterophylla BL. Mus. Bot. Lugd. Bat. 1 (1850) 257; WANGERIN, Pfl. Reich Heft 41⁴ (1910) 28; DANSER, Blumea 1 (1934) 69; MATTHEW, Blumea 23 (1976) 90. — HALLIER f. suggested this to be *Gomphandra capitulata* BECC., but this was questioned by SLEUMER, Blumea 17 (1969) 193. According to us this sterile sheet (L 901, 169–350) collected by PRAETORIUS in Palembang, is not a *Mastixia* but we cannot give a proper identification.

Mastixia tetrandra (THW.) CLARKE. — DANSER, Blumea 1 (1934) 56, referred two Sumatran specimens to this species, which is hitherto only found in Ceylon and the Andaman Is. One of these is sterile and the other is in bud; they can equally well be referred to *M. rostrata ssp. rostrata*, and their identification remains doubtful. Cf. MATTHEW, Blumea 23 (1976) 77.

Excluded

Cornus caudata HASSK. & ZOLL., nom. illeg., *C. ilicifolia* (BL.) HASSK. & ZOLL., *C. serrulata* (BL.) HASSK. & ZOLL., and *C. stricta* ZOLL. & MOR. are all combinations or names made by HASSKARL and ZOLLINGER based on *Polyosma* BL., because of their opinion that this genus of the *Saxifragaceae* would be synonymous with *Cornus* L. Cf. HASSKARL, Cat. Hort. Bog. (1844) 168 and ZOLLINGER, Natuur- & Geneesk. Arch. Neêrl. Ind. 2 (1845) 10.

ONAGRACEAE (P. H. Raven, St. Louis)¹

Annual or perennial herbs (in Mal.), occasionally somewhat woody near the base, sometimes aquatic. *Leaves* spiral or opposite. Stipules absent or reduced, deltoid. *Flowers* mostly 4-merous, rarely 5-merous (in Mal.), solitary or arranged in a terminal racemose inflorescence, subtended by (often reduced) leaves or bracts. Bracteoles absent or 2 at the base of the ovary. Floral tube short or absent. *Sepals* erect, persistent. *Petals* caducous, contorted in aestivation, white, pink or yellow, sometimes emarginate. *Stamens* 4, 5, 8, or 10, in 2 whorls, rarely with an intermediate number, epipetalous ones sometimes shorter. *Anthers* usually versatile, sometimes seemingly basifixed by reduction: pollen single or in tetrads. *Ovary* inferior, (in Mal.) 4- or 5-celled and with ∞ ovules; summit of the ovary (disk) flat to conical (in Mal.), sometimes with depressed nectaries surrounding the bases of the epipetalous stamens. *Style* simple; stigma capitate, clavate or globose, often 4-lobed. *Ovules* with axial placentation, 1-pluriseriate. *Fruit* (in Mal.) a mostly long and slender loculicidal or irregularly rupturing capsule. *Seeds* rounded or elongate, in *Ludwigia* sometimes embedded in powdery or surrounded by cork-like endocarp tissue, in *Epilobium* with a chalazal plume of trichomes (coma); endosperm absent; embryo straight.

Distribution. About 17 genera and more than 600 *spp.* in tropical and temperate regions, with a distinct centre of diversity on the northern hemisphere in the New World, in *Malesia* two native genera which are both almost ubiquitous.

Ecology. *Ludwigia* is largely confined to the hot lowland and hills usually in wet or damp localities, *Epilobium* is confined to the higher mountain regions.

Dispersal. *Epilobium spp.* are manifestly wind dispersed by virtue of their coma. *Ludwigia spp.* depend on dispersal by water and possibly incidental exozooic dispersal by water birds; in *Ludwigia hyssopifolia* there are two kinds of seed, one of which is enveloped by a corky tissue derived from the endocarp, enhancing their buoyancy.

Pollination. Almost all of the Malesian species are self-pollinated, shedding pollen directly on the stigma at or before anthesis and rarely visited by insects. In *Ludwigia peruviana*, introduced in the Old World, the anthers are extrorse and shed pollen away from the stigma; thus outcrossing is predominant. Some outcrossing probably also occurs in the relatively large-flowered *L. adscendens* and *L. octovalvis*, which are known to be visited by insects, and in *Epilobium detznerianum*, in some populations of which the stigma is even held above the anthers. In our area, HEIDE (Dansk Bot. Ark. 5, 1927, 18) reported *Melipona sp.*, a bee, visiting the flowers of *Ludwigia peruviana* (as *Jussieuia peruviana*), and *Bombus rufipes* at the flowers of the locally naturalized *Oenothera stricta* (as *O. lamarckiana*) and *Fuchsia magellanica* (as *F. coccinea*). The *Melipona* bees were not observed to contact the anthers or stigma of the large-flowered *Ludwigia*, but would certainly do so in visiting smaller-flowered species. All of the Malesian species are genetically self-compatible.

Morphology & Anatomy. The *Onagraceae* are distinctive in their monosporic, 4-nucleate, 'Oenothera type' embryo sac development; in the nearly universal presence of viscin threads among the pollen; and in the loose construction of their pollen exine. Most species of *Epilobieae* and about half of *Ludwigia* shed their mature pollen in tetrads; these include all Malesian species except *L. adscendens* and *L. hyssopifolia*, in which the pollen is shed singly. Intraxylary phloem occurs throughout the family adjacent to primary xylem, and interxylary phloem (included phloem) is found in many genera but not in *Ludwigia* (CARLQUIST, Ann. Mo. Bot. Gard. 62, 1975, 386); in these features *Onagraceae* resemble many other *Myrtales*.

The stomata are surrounded by three or more subsidiary cells, sometimes resembling those of *Cruciferae*.

All *Onagraceae* have an inferior ovary and a floral tube, which is prolonged beyond the ovary in all except *Ludwigia* and *Epilobium sect. Chamaenerion*.

In several species of *Ludwigia* half-submerged parts of the stem are covered by a whitish aerenchyma; in *L. adscendens* short roots at the nodes are transformed into inflated, elongate aerophores enhancing floating on water.

Chromosomes. All species of *Epilobium sect. Epilobium*, a taxon that includes all Malesian species, which have been examined have had a gametic chromosome number of $n = 18$. Species of *Ludwigia* have a gametic chromosome number of $n = 8$ and multiples. These genera differ from most others in *Onagra-*

(1) With co-operation of the General Editor in framing the manuscript.

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ceae in having small chromosomes that are heteropycnotic and dark-staining throughout the mitotic cycle. Naturally occurring interchange heterozygotes, abundant in the tribe *Onagreae*, are not known to occur in either group. The original basic chromosome number of the family is $x = 11$, as in *Fuchsia*, *Circaea*, and others.

Hybridization. Hybrids are rare between the recognized species of *Ludwigia*. In *Epilobium* sect. *Epilobium* they are occasional where two or more entities come together, but their occurrence is limited by the predominant autogamy or cleistogamy of most species and to some extent by ecological differentiation also. A wide range of fertilities is characteristic of these hybrids, as explained in detail in our monograph of the Australasian species (RAVEN, D.S.I.R. New Zeal. Bull. 216, 1976), and cytoplasmic differences sometimes occur. Two of the Malesian species occur together in N. Luzon, and a few individuals suggest hybridization; four occur together in the mountains of New Guinea, with hybrids probably occasional but poorly studied so far. All species of *Epilobium* found in Malesia have the same chromosome arrangement that is predominant in Eurasia, from where they doubtless came.

Chemotaxonomy. Raphides, needle-like crystals of calcium oxalate, are ubiquitous in the vegetative parts of *Onagraceae*. The few reports of alkaloids are doubtful and seem to indicate rather the presence of secondary amines. Ellagic acid occurs. Among the flavonoids reported from the family, flavonols based on quercetin are ubiquitous, whereas kaempferol and more highly oxygenated types based on myricetin are frequent. The anthocyanins include predominantly malvidin and cyanidin derivatives, with the latter predominant in the rose-purple petals of *Epilobium*. The yellow petals of most species of *Ludwigia* are colored by carotenoids, with the chalcone isosalipurposide forming a non-ultraviolet-reflective centre in many species, including *L. peruviana*.

Uses. Only some species of *Ludwigia* are mentioned to be in use for minor medicinal purposes; see under *Ludwigia* spp.

KEY TO THE GENERA

1. Capsule loculicidally dehiscent with 4 valves; axis persistent. Seeds comose. Floral tube present. Petals 4, white, pinkish or red. Stamens 8. Stem-base without aerenchyma. 2. *Epilobium*
1. Capsule irregularly dehiscent; axis not persistent. Seed not comose. Floral tube absent. Petals yellow, if white or creamy then flowers 5-merous and floating aquatic plant adorned with short spongy aerenchyma-roots at the nodes. Stamens 4-10. Stem-base not rarely covered by aerenchyma. 1. *Ludwigia*

1. LUDWIGIA

LINNÉ, Gen. Pl. (1754) 55; Sp. Pl. 1 (1753) 118; MUNZ, Bull. Torr. Bot. Cl. 71 (1944) 152; HARA, J. Jap. Bot. 28 (1953) 289; A. & R. FERNANDES, Garcia de Orta 5 (1957) 109; RAVEN, Reinwardtia 6 (1963) 327. — *Jussiaea* LINNÉ, Gen. Pl. (1754) 183; Sp. Pl. 1 (1753) 388; BACK, Trop. Natuur 3 (1914) 59; FAWCETT, J. Bot. 64 (1926) 10; MUNZ, Darwiniana 4 (1952) 179. — *Nematopyxis* MIQ. Fl. Ind. Bat. 1, 1 (1855) 600. — **Fig. 1, 4, 5.**

Slender herbs, erect or creeping and rooting at the nodes, to large shrubs. Underwater parts often swollen and spongy or bearing inflated white spongy aerenchyma. *Leaves* alternate or opposite, mostly entire. Stipules absent or reduced, deltoid. *Flowers* borne singly, clustered, or arranged in an inflorescence. Bracteoles lacking or conspicuous, usually two, at or near the base of the ovary. Floral tube absent. *Sepals* 3-7, persistent after anthesis. *Petals* as many as the sepals or absent, caducous, yellow or white, with contorted aestivation. *Stamens* as many as or twice as many as the sepals, or flowers very rarely with an intermediate number of stamens; anthers usually versatile but sometimes apparently basifixed by reduction. Pollen shed in tetrads or singly. Disk (summit of the ovary) flat to conical, often with depressed nectaries surrounding the bases of the epipetalous stamens. *Stigma* hemispherical or capitate, the upper $1\frac{1}{2}$ - $\frac{2}{3}$ receptive, often lobed, the number of lobes corresponding to the number of locules. *Ovary* with a number of cells equal to the number of sepals, very rarely more; placentation axial; ovules pluriseriate or uniseriate in each cell, in one species uniseriate below, pluriseriate above; if uniseriate, the seeds sometimes embedded in powdery or woody endocarp

from which they detach easily or with difficulty. *Capsule* irregularly dehiscent, or by a terminal pore, or by flaps separating from the valve-like top. *Seeds* rounded or elongate, the raphe usually easily visible and in some sections equal or nearly equal in size to the body of the seed.

Distr. According to my synopsis (Reinwardtia 6, 1963, 329) 75 spp., all over the world; in *Malesia* 6 spp., one of which is certainly introduced.

Ecol. One aquatic and the other species mostly in swampy or damp places, often in rice-fields, from the lowland up to c. 2100 m, mostly below 1000 m. Flowers last only one day.

Taxon. I have divided the genus into 17 sections, the largest of which (*sect. Myrtocarpus*) is neotropical. They are often shrubby with large, 4- or 5-merous flowers, dimerous stamens, prominently 4- or 5-ribbed capsules, free seeds and pollen grains shed in tetrads. They appear phylogenetically central in the genus. In *Malesia* this section is represented by an introduced weed, *L. peruviana*. Close to this section are one African (*sect. Africana*) and one American section (*sect. Macrocarpon*) with terete capsules. Following these is a series of small Old World sections which have the stamens reduced to one whorl; in one African section flowers are 3-merous. *L. hyssopifolia* forms a monotypic section unique in having two kinds of seeds, those in the lower part of the capsule uniseriate and embedded in the endocarp, those in the upper part pluriseriate and free, while pollen grains are single. Other sections, not represented in *Malesia*, have all of the seeds loosely embedded in powdery endocarp. The structure of the seed is important in the discrimination of sections.

The second major line of the genus consists of species in which the seeds are embedded in coherent chunks of woody endocarp which render the capsule a tough unit from which it is difficult to separate the seeds. The two sections belonging to this line have basically 5-merous flowers and pollen shed singly. Through the disentangling of these relationships it appears that the number of stamens is not decisive for dividing the genus into two genera as this would go across relationships and lead to heterogeneous assemblages of species.

Each *Malesian* species belongs to a different section and being so small in number it seems not useful to give descriptions of these sections; I refer to my revision (1963).

The cradle of the genus is probably South America with an important secondary centre of evolution in Africa. It is one of the most primitive genera in the family.

Note. It has appeared that seeds retain viability in the herbarium in unpoisoned, not too old specimens; flowering plants can thus be raised from fruiting herbarium specimens.

KEY TO THE SPECIES

1. Stamens twice as many as sepals.
 2. Seeds pluriseriate, free (not embedded in endocarp).
 3. Plant subglabrous to appressed-pubescent. Capsule terete. Petals 5–17 by 4–17 mm. Style 1.5–3.5 mm. Raphe equal in diameter to the body of the seed 2. *L. octovalvis*
 3. Coarse, strongly pubescent or villous plant. Capsule strongly 4-angled, villous, with flat sides. Petals 15–24 by 16–26 mm. Style 1 mm long. Raphe not more than $\frac{1}{4}$ the diameter of the body of the seed 1. *L. peruviana*
 2. Seeds at least below uniseriate and embedded in endocarp.
 4. Seeds in the c. $\frac{1}{4}$ upper part of the capsule pluriseriate and free. Sepals 4. Petals 2–3 mm long 5. *L. hyssopifolia*
 4. Seeds all uniseriate in each cell of the capsule and embedded in endocarp. Sepals 5–7 (rarely 4). Petals 4.5–23 mm long.
 5. Aquatic, with floating branches forming erect clusters of spongy, spindle-shaped aerophores (aerenchyma). Petals white or creamy, with yellow at the base 6. *L. adscendens*
 5. Plant not forming such aerophores on the decumbent branches. Petals bright golden-yellow with a darker spot at the base. New Zealand, Australia, Pacific Is., Formosa, China, and Japan, also in the New World, might possibly be found in East Malesia. Cf. ASTON, Aquat. Pl. Austr. (1973) 144, f. 55 *L. peploides* (H.B.K.) RAVEN
1. Stamens as many as sepals, very rarely more in some flowers.
 6. Seeds pluriseriate in each cell of the capsule. Petals elliptical, 1–3 by 0.7–2 mm. Capsule terete. Seeds 0.3–0.5 by 0.2–0.25 mm 3. *L. perennis*
 6. Seeds uniseriate in each cell of the capsule. Petals narrow spatulate, 1.3–2.2 by 0.4–0.9 mm. Capsule slightly 4-angled. Seeds 0.5–0.6 by 0.3 mm 4. *L. prostrata*

1. *Ludwigia peruviana* (L.) HARA, J. Jap. Bot. 52 (1953) 293; RAVEN, Reinwardtia 6 (1963) 345, map 14. — *Jussiaea peruviana* LINNÉ, Sp. Pl. 1 (1753) 388; BACK, Trop. Natuur 3 (1914) 61; ONKR. Suiker. (1930) 470, Atlas t. 445; ALSTON in Trimen, Fl. Ceyl. 6 (1931); MUNZ, Darwiniana 4 (1942) 131;

Steen. Fl. Sch. Indon. (1949) 305. — *Oenothera hirta* LINNÉ, Sp. Pl. ed. 2, 1 (1762) 491. — *Jussiaea hirta* (L.) SW. Obs. Bot. (1791) 142, non LAMK, 1789; BACK, Ann. Jard. Bot. Btztg Suppl. 3 (1909) 406. — *Jussiaea speciosa* RIDL. J. Bot. 59 (1921) 259; Fl. Mal. Pen. 1 (1922) 828.

Shrub 0.5–3 m, entirely villous, the hairs often multicellular, especially in the inflorescence; long inflated aerophores arising from submerged, buried roots. *Leaves* lanceolate to broadly lanceolate, 4–12 by 0.3–1.5 cm, narrowly cuneate at base, apex acute to acuminate; nerves 12–22 pairs; submarginal vein not prominent; petiole 3–12 mm. *Flowers* in upper leaf axils. Bracteoles lacking or up to 7 mm long, subulate. *Sepals* 4 or 5, lanceolate, irregularly serrulate, 10–18 by 4–8 mm, villous. *Petals* bright yellow, veiny, suborbicular, 15–24 by 16–26 mm, shallowly emarginate, with a claw 1–3 mm. *Stamens* 8 or 10, subequal; filaments 2–3.5 mm; anthers 3–4.5 mm long, extrorse and not shedding pollen directly on the stigma at anthesis. Pollen shed in tetrads. Disk elevated 1–2 mm, with a depressed densely white-hairy nectary around the base of each epipetalous stamen. *Style* c. 1 mm; stigma broadly elongate-hemispherical, 2–3 mm high. *Capsule* villous, 1.2–3 by 0.6–1 cm, light yellowish brown with 4 prominent dark brown ribs, 4-angled, thin-walled, readily and irregularly loculicidal; pedicel 2–4.5 cm. *Seeds* pluriseriate in each cell, free, light brown, finely striate and cellular pitted, obovoid, 0.6–0.8 mm long; raphe $\frac{1}{4}$ to $\frac{1}{5}$ the width of the body.

Gametic chromosome number (Old World populations), $n = 40$.

Distr. Native of the New World, from the SE. United States throughout South America, introduced and naturalized in *Malesia* since the 2nd half of the last century, collected in Malaya, Sumatra, Java (common in West), but obviously still absent from many areas.

Ecol. Along ditches and in moist places, mostly in the lowland but ascending to c. 1400 m. *Fl.* Jan.–Dec.

Vern. Banka: *pitjanket*, M; Java: *tjatjabéan*, S, *lombokan*, J.

Note. BACKER (Onkr. Suiker. 1930, 470) observed that in inundated situation the plant produces aerophores which are emitted by shallow, horizontal roots; they are erect but their tips usually float on the water.

2. *Ludwigia octovalvis* (JACQ.) RAVEN, Kew Bull. 15 (1962) 476; Reinwardtia 6 (1963) 356, maps 19–20, incl. *ssp. brevisepala* (BRENAN) RAVEN et *ssp. sessiliflora* (MICH.) RAVEN; HENRY & PRITCHARD, Bot. Div. Lac. Bot. Bull. 7 (1973) 132, fig.; EVERIST, Pois. Pl. Austr. (1974) 393. — *Jussiaea suffruticosa* LINNÉ, Sp. Pl. 1 (1753) 388; BTH. Fl. Austr. 3 (1867) 307; F.v.M. Descr. Not. Pap. Pl. 4 (1876) 60; CLARKE, Fl. Br. Ind. 2 (1879) 587; KOORD. Exk. Fl. Java 2 (1912) 703; RIDL. Trans. Linn. Soc. Bot. II, 9 (1916) 57, incl. *var. hirta* RIDL.; GAGN. Fl. Gén. I.-C. 2 (1921) 986; C. T. WHITE, Proc. R. Soc. Queensl. 34 (1922) 48; BACK. & BAKH. f. Fl. Java 1 (1963) 261. — *Oenothera octovalvis* JACQ. En. Syst. Pl. (1760) 19. — *Jussiaea pubescens* LINNÉ, Sp. Pl. ed. 2, 1 (1762) 555. — *L. perennis* (non L.) BURM. f. Fl. Ind. (1768) 37. — *Jussiaea angustifolia* LAMK, Encycl. 3 (1789) 331. — *Jussiaea villosa* LAMK, l.c.; RIDL. Fl. Mal. Pen. 1 (1922) 828. — *Jussiaea octovalvis* (JACQ.) SW. Obs. Bot. (1791) 142. — *Jussiaea angustifolia* BL. Bijdr. (1826) 1132, non LAMK, 1789; BACK. Trop. Natuur 3 (1914) 62. — *Jussiaea blumeana* DC. Prod. 3 (1828) 55. — *Jussiaea burmannii* DC.

l.c. 57. — *Jussiaea exaltata* ROXB. (Hort. Beng. 1814, 33, *nomen*) Fl. Ind. ed. Carey 2 (1832) 401. — *Jussiaea costata* PR. Epim. Bot. (1849) 217. — *Jussiaea junghuhniana* MIQ. Fl. Ind. Bat. 1, 1 (1855) 627; VAL. Bull. Dép. Agric. Ind. Néerl. 10 (1907) 41. — *Jussiaea erecta* (non L.) RIDL. J. Bot. 59 (1921) 258; Fl. Mal. Pen. 1 (1922) 827, incl. *var. exaltata* (ROXB.) RIDL.; BACK. Onkr. Suiker. (1930) 470, Atlas t. 446; STEEN. Arch. Hydrobiol. Suppl. 10 (1932) 314. — *L. pubescens* (L.) HARA, J. Jap. Bot. 28 (1953) 293. — Fig. 1.

Usually robust, well-branched herb, sometimes woody at the base, up to 4 m, subglabrous or with sparse or dense appressed or spreading pubescence. *Leaves* lanceolate or narrowly lanceolate, to narrowly ovate, or subovate, 2–14 by 0.5–4 cm, narrowly to broadly cuneate at the base and attenuate at apex; nerves 11–20 pairs, submarginal vein well developed; petiole up to 1 cm. Bracteoles reduced or to 1 mm long. *Sepals* 4, ovate or lanceolate, 6–15 by 1–7.5 mm. *Petals* yellow, broadly obovate or cuneate, emarginate, 17 by 2–17 mm. *Stamens* 8, epipetalous ones shortest; filaments 1–4 mm long; anthers 0.5–4 mm long, extrorse but soon crumbling and shedding pollen directly on the stigma. Pollen shed in tetrads. Disk slightly raised, with a white-hairy sunken nectary surrounding the base of each epipetalous stamen. *Style* 1.5–3.5 mm; stigma subglobose, shallowly 4-lobed, 1.2–3 mm Ø. *Capsule* thin-walled, 1.7–4.5 cm by 2–8 mm, terete, pale brown with 8 darker ribs, readily and irregularly loculicidal; pedicel up to 10 mm. *Seeds* pluriseriate in each cell, free, brown, rounded, 0.6–0.75 mm long, 0.5–0.7 mm wide including the inflated raphe which is equal in size to the body of the seed and evenly transversely ridged.

Gametic chromosome numbers, $n = 16, 24$.

Distr. Throughout the tropics of the world, between c. 32° N and 30° S.

Ecol. Mostly in humid places, damp grassland, rice-fields, along ditches and water-courses, in swamps, lakes and pools, drains, sandy or silty floodbanks, gravelly riverbeds, on floating islands in lakes, on floating logs in lagoons, sago swamps, mountain peat swamps with sedges, also in old native gardens and coconut plantings, from the lowland up to c. 1000 m, in Java and Celebes up to 1400 m, in New Guinea up to 2100 m. *Fl.* Jan.–Dec.

Several collectors mention that it propagates by runners and that old leaves turn reddish. The lower part of the stem is at times coated by aerenchyma. In inundated condition aerophores are produced; see under 1. *L. peruviana*.

DOCTERS VAN LEEUWEN (Zoöcecidia, 1926, 427 f. 808; Ned. Kruidk. Arch. 51, 1941, 204) recorded fruit galled by beetles and aphid galls on the terminal leaves of the branches.

Uses. In Java minor medicinal qualities are ascribed to this species, amongst others against sprew. RUMPHIUS, who described it under the name *herba vitiginum* (Herb. Amb. 6, p. 49) did not mention uses (HEYNE, Nutt. Pl. 1927, 1206). BURKILL (Dict. 1935, 1274) reported that the mucilaginous leaves, after which the plant is called 'lakom ayer' = 'water Vitis', are used for poulticing in a variety of complaints; it has also been recorded as used for headaches, orchitis, glands in the neck,



Fig. 1. *Ludwigia octovalvis* (JACQ.) RAVEN. a. Habit in flower, b. withered fruits, both $\times \frac{1}{2}$ (a after BACKER, 1940, b JUNGHUHN CCXXII).

diarrhoea, dysentery, nervous diseases, and as a vermifuge. In WILKINSON'S Dictionary it is said that a kind of tea is made from the leaves. Also in India medicinal properties are ascribed to it.

Vern. Malaya: *buyang samalam*, *lakom ayër*, *pujang malam*, *yènlidah*, M; Sumatra: *urang aring itèm*, Simalur I.; Java: *gagabusan*, *tjatjabèan*, S. *kalamènja*, Md. *salah njowo*, J; Lesser Sunda Is.: *pangambo*, E. Sumbawa; Philippines: *tayilakton*, Tag., *balansuit*, Mag., *malapáko*, *túbong-talapan*, Bik., *pachar-pachar*, Sul., *palangdisin*, Ig., *talangkau*, Ilk., *halangot*, *naudyawa tubig*, If.; Celebes: *kèlètèlè tèngèn*, Tonsaw. dial., Minahassa; Moluccas: *daun panu*, Ambon; New Guinea: *ewo*, *onarenare*, Kapauko lang., *kampur*, Sakaj bivouac, Merauke, *pfaufanu*, Kutubu, *mayenke*, Orne lang., *Kaiye*, *rowijetwi*, Enga lang., *Yogos*, *togorarah*, Wapi lang., Marok, *rama-rama*, Matapaili lang.

Note. In my revision (1963) I distinguished three subspecies, more or less geographically defined, which I wish to withdraw here.

3. *Ludwigia perennis* LINNÉ, Sp. Pl. 1 (1753) 119; A. & R. FERNANDES, Garcia de Orta 5 (1957) 114, 475; RAVEN, Reinwardtia 6 (1963) 367, map 21. — *L. parviflora* ROXB. (Hort. Beng. 1814, 11, *nomen*) Fl. Ind. 1 (1820) 440; BTH. Fl. Austr. 3 (1867) 307; KURZ, J. As. Soc. Beng. 46, ii (1877) 91; CLARKE, Fl. Br. Ind. 2 (1879) 588; TRIMEN, Fl. Ceyl. 2 (1894) 234; RIDL. Fl. Mal. Pen. 1 (1922) 828; BACK. Onkr. Suiker. (1930) 471, Atlas t. 447; BACK. & BAKH. f. Fl. Java 1 (1963) 261. — *L. lythroides* BL. Bijdr. (1826) 1134. — *L. gracilis* MIQ. Fl. Ind. Bat. 1, 1 (1855) 629. — *Jussiaea perennis* BRENNAN, Kew Bull. 8 (1953) 163.

Annual herb up to 1 m, subglabrous or minutely puberulent on younger parts. Leaves narrowly elliptic to lanceolate, 1–11 by 0.3–2.7 cm, narrowly cuneate at base, apex subacute; nerves 6–12 pairs; submarginal vein weakly developed; petiole 2–15 mm, winged. Sepals 4, rarely 5, deltoid, (1.3–)2–3.5 by (0.5–)0.7–1.8 mm, glabrous or minutely puberulent. Petals yellow, elliptic, 1–3 by 0.7–2 mm. Stamens usually 4 or 5, rarely more; filaments 0.3–0.7 mm; anthers 0.5–0.7 by 0.5–0.7 mm, shedding pollen directly on the stigma at anthesis. Pollen shed in tetrads. Disk slightly elevated, glabrous. Style 0.7–1.5 mm; stigma globose, 0.4–0.5 mm \varnothing . Capsule thin-walled, glabrous or puberulent, 3–16 (–19) mm long, terete, pale brown, readily and irregularly loculicidal; capsule sessile or on a pedicel up to 6 mm, often \pm nodding. Seeds pluriserial in each cell, free, brown with fine brown lines, ellipsoid-rounded, 0.3–0.5 by 0.2–0.25 mm; raphe very narrow and inconspicuous.

Gametic chromosome number, $n = 8$.

Distr. Tropical Africa (from Senegal, Lake Chad, and the Sudan south to E. Congo and N. Natal), Madagascar, through continental SE. Asia (Ceylon to S. China, Hongkong, and Hainan), and throughout Malesia (except Borneo and Moluccas) to tropical Australia and New Caledonia. Fig. 2.

Ecol. Sunny, humid or marshy situations fallow rice-fields, sawah dikes, along ditches, rivers and water-courses, dry riverbeds, sugarcane fields on heavy clay, damp places in Eucalypt savannah (New Guinea), from the lowland to c. 500 m. Fl. Jan.–Dec.

In Java and Madura I. decidedly preferring regions subject to a dry monsoon.

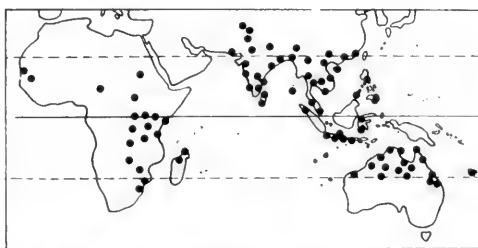


Fig. 2. Range of *Ludwigia perennis* L. (after RAVEN, 1963).

4. *Ludwigia prostrata* ROXB. (Hort. Beng. 1814, 11, *nomen*) Fl. Ind. 1 (1820) 441; BTH. Fl. Austr. 3 (1866) 308; CLARKE, Fl. Br. Ind. 2 (1879) 588; TRIMEN, Fl. Ceyl. 2 (1894) 234; MERR. Fl. Manila (1912) 355; RIDL. Fl. Mal. Pen. 1 (1922) 829; MERR. En. Philip. 3 (1923) 220; BACK. Onkr. Suiker. (1930) 472, Atlas t. 448; BACK. & BAKH. f. Fl. Java 1 (1963) 261; RAVEN, Reinwardtia 6 (1963) 374, map 23. — *L. fruticulosa* BL. Bijdr. (1826) 1133. — *L. leucorhiza* BL. l.c. — *Nematopyxis pusilla* MIQ. Fl. Ind. Bat. 1, 1 (1855) 630. — *Nematopyxis prostrata* MIQ. l.c. — *Nematopyxis fruticulosa* MIQ. l.c.

Annual herb 0.1–0.6 m, subglabrous, often reddish-tinged. Leaves elliptic or narrowly elliptic, 1–13 by 0.3–2.7 cm, glabrous or with a few minute hairs along the veins, narrowly cuneate at the base, apex acute; submarginal vein weakly developed; petioles 4–25 mm, distinct. Sepals 4, deltoid, 1.3–2.5 by 0.7–1.1 mm, glabrous. Petals yellow, narrowly spatulate, 1.3–2.2 by 0.4–0.9 mm. Stamens 4; filaments 0.8–1.2 mm; anthers 0.4–0.5 mm wide, broader than long, closely appressed to the stigma and shedding pollen directly on it at anthesis. Pollen shed in tetrads. Disk slightly elevated, glabrous. Style c. 1 mm; stigma globose, c. 0.5 mm, the upper half receptive. Capsule thin-walled, glabrous, 12–22 by 0.8–1 mm, \pm 4-angled, pale brown, readily and irregularly loculicidal, the seeds showing plainly as indentations in the walls at maturity. Seeds uniseriate in each cell, free, pale brown, speckled or striped transversely with narrow darker brown stripes, plump, ovoid, apiculate at one end, 0.5–0.6 by 0.3 mm; raphe narrow, linear.

Gametic chromosome number, $n = 8$.

Distr. Tropical SE. Asia (Ceylon and S. Deccan to N. India, Assam, S. China and Andamans); in Malesia: Malay Peninsula, Java, Lesser Sunda Is. (Timor), Borneo, and Philippines (Palawan, Luzon, Negros, Mindanao). The single record from Australia (N. Queensland: Mossman R.) recorded by C. T. WHITE (Proc. R. Soc. Queensl. 50, 1939, 78) is a misidentification of *L. hyssopifolia*. On the whole *L. prostrata* is in Malesia a rare species. Fig. 3.

Ecol. Paddies, fallow and planted, by ditches, along riverbanks, in swampy places, rather rare, from lowland up to c. 800 m. Fl. Jan.–Oct.

Vern. Philippines: *alubihud*, P.Bis.

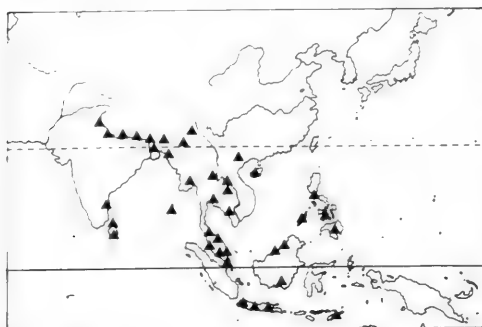


Fig. 3. Range of *Ludwigia prostrata* ROXB. (after RAVEN, 1963).

5. *Ludwigia hyssopifolia* (G.DON) EXELL, Garcia de Orta 5 (1957) 471; A. & R. FERNANDES, l.c. 471, 474; RAVEN, Reinwardtia 6 (1963) 385, map 30; HENTY & PRITCHARD, Bot. Div. Lac, Bot. Bull. 7 (1973) 131, fig. — *Jussiaea linifolia* VAHL, Eclog. Am. 2 (1798) 32, non *L. linifolia* POIR. 1813; BACK. Trop. Natuur 2 (1913) 20, fig.; *ibid.* 3 (1914) 61; Onkr. Suiker. (1930) 469, Atlas t. 444; STEEN. Arch. Hydrobiol. Suppl. 10 (1932) 314; BACK. & BAKH. f. Fl. Java 1 (1963) 260. — *Jussiaea hyssopifolia* G.DON, Gen. Syst. 2 (1832) 693. — *Jussiaea suffruticosa* (non L.) RIDL. J. Bot. 59 (1921) 257; Fl. Mal. Pen. 1 (1922) 827. — *L. prostrata* (non ROXB.) C. T. WHITE, Proc. R. Soc. Queensl. 50 (1939) 78. — Fig. 4.

Annual herb 5 cm to 3 m, often becoming woody at the base; young growth and inflorescence minutely puberulent; elongate aerophores arising from buried submerged roots. Leaves lanceolate, 1–9 by 0.2–3 cm, narrowly cuneate at the base, apex acuminate; nerves 11–17 pairs; submarginal vein not prominent; petiole 2.5–18 mm. Sepals 4, lanceolate, 2–4 by 0.7–1.2 mm, finely puberulent, 3-nerved. Petals yellow, fading orange-yellow, elliptic, 2–3 by 1–2 mm. Stamens 8, pale greenish yellow, epipetalous ones shorter; filaments of episepalous stamens 1–2 mm, those of epipetalous ones 0.5–1 mm; anthers 0.4–0.6 mm wide, 0.2–0.3 mm high, shedding pollen directly onto the stigma at anthesis. Pollen grains shed singly. Disk \pm elevated, with a depressed ciliate nectary surrounding the base of each epipetalous stamen. Style pale greenish yellow, 1–1.5 mm; stigma depressed-globose, c. 0.6–1.2 mm \varnothing , 0.5–0.8 mm high, shallowly 4-lobed, the upper portion receptive. Capsule relatively thin-walled, finely puberulent, 1.5–3 cm by 1–1.2 mm, subterete, enlarged in the upper $\frac{1}{6}$ to $\frac{1}{3}$, subsessile. Lower seeds uniseriate in each cell of the capsule, nearly vertical, brown, oblong, 0.7–0.85 mm long, each firmly embedded in a cube of relatively hard endocarp; raphe $\frac{1}{3}$ the diameter of the body. Seeds in upper inflated portion of the capsule multiseriate, free, ovoid, 0.35–0.5 mm long, paler brown than the lower seeds and with a narrower raphe. Lower part of capsule at first marked by distinct bumps corresponding to the position of the uniseriate seeds, but as the endocarp hardens and swells, the capsule becomes smooth.

Gametic chromosome number, $n = 8$.

Distr. Tropical Africa (Dakar to Lake Chad, S. Sudan and S. Congo), continental SE. Asia (Ceylon to Hainan), throughout *Malesia* to Micronesia and N. Australia (Cape York Peninsula and Arnhem Land).

It is difficult to fix the native country of this now widely spread palaeotropical weed which has no close relatives. It might have been introduced in tropical Africa where it is relatively local and confined to the west, but it was collected in São Tomé as early as 1822.

Ecol. A very common weed of pools, along drains, shallow ditches, water and river edges, in paddies and humid, fallow garden land, on waste land, fallow sawahs, and in clearings, both on clay and humid white sand (Borneo), in pools in Eucalypt savannah (Wetar I.), on Mt Kelud (Central Java) as a pioneer on old volcanic mudstreams (lahars), from the plains up to c. 1000 m. Fl. Jan.–Dec.

BACKER (Trop. Natuur 2, 1913, 133) described in detail the biology of this species, of which the flowers open at 7 a.m. Seeds are gradually released by decay of the pericarp of which the vessels remain persistent. To his surprise both kinds of seed were buoyant for 16 days, after which they sank. On the 17th day he observed one buoyant seedling, but unfortunately no mention was made from which kind of seed; his experiment was through interference discontinued. He made also notes on the aerophores emitted by the shallow roots as occur also in *L. peruviana* and other species.

DOCTERS VAN LEEUWEN (Zooecidia, 1926, 428; Ned. Kruidk. Arch. 51, 1941, 204) reported galled fruits caused by beetles.

Leaves are often attacked by a blue beetle: *Graptodera cyanea* (BACKER, Trop. Natuur 2, 1913, 132).

Uses. HEYNE (Nutt. Pl. 1927, 1206) noted that in N. Celebes it is used for poulticing pimples. According to BURKILL (Dict. 1935, 1273) it is in Malaya generally stocked by Chinese herbalists, but its use is not clear; it was once recorded that an infusion of the root is swallowed by Malays for syphilis. In the Philippines the whole plant is used for black dye (QUISUMBING, Medic. Pl. Philip. 1951, 676).

Vern. Sumatra: *mëligai*, M, Banka; Java: (*djukut*) *anggerëman*, *mainang*, *tjatjabèan*, S; Philippines: *pasau-na-hapat*, *sila sila*, Tag., *ilamnum-wiliyan*, Mag., *kakaggin diloba*, If., *barigaud*, Bik., *manakatud*, Ilk., *talang-duron*, Pamp., *tohod-tòhod*, Bik.; Celebes: *kayu ragi*, Manado.

Note. The dimorphic seeds are very unusual and it would be most interesting to have information on the properties of the two seed types with respect to germination.

6. *Ludwigia adscendens* (L.) HARA, J. Jap. Bot. 28 (1953) 290; A. & R. FERNANDES, Garcia de Orta 5 (1957) 475; RAVEN, Reinwardtia 6 (1963) 387, maps 31, 33; ASTON, Aquat. Pl. Austr. (1973) 142; HENTY & PRITCHARD, Bot. Div. Lac, Bot. Bull. 7 (1973) 130, fig. — *Jussiaea repens* LINNÉ, Sp. Pl. 1 (1753) 388, non *L. repens* FORST. 1771; F.v.M. Descr. Not. Pap. Pl. 4 (1876) 60; CLARKE, Fl. Br. Ind. 2 (1879) 587; O. K. Rev. Gen. Pl. 1 (1891) 251, incl. var. *pilosa* O. K. et var. *glaberrima* O. K.; TRIMEN, Fl.



Fig. 4. *Ludwigia hyssopifolia* (G. DON) EXELL. a. Habit, in flower, b. withered fruits, both $\times \frac{1}{2}$ (a after BACKER, 1940, b VERBOOM 9).

Ceyl. 2 (1894) 233; KOORD. Exk. Fl. Java 2 (1912) 703; BACK. Trop. Natuur 3 (1914) 56, 60, f. 1-5; RIDL. Fl. Mal. Pen. 1 (1922) 827; GAGN. Fl. Gén. I.-C. 2 (1925) 987; HOCHR. Candollea 3 (1925) 479, incl. *ssp. glabrata* HASSL. f. *albiflora* HOCHR.; HARTSEMA, Flora (Allg. Bot. Z). n.s. 22 (1927) 242, t. 3; BACK. Onkr. Suiker. (1930) 469, Atlas, t. 443; STEEN. Arch. Hydrobiol. Suppl. 10 (1932) 314, f. 62; Fl. Sch. Indon. (1949) 305; BACK. & BAKH. f. Fl. Java 1 (1963) 260. — *Jussiaea adscendens* LINNÉ, Mantissa 1 (1767) 69. — *Jussiaea fluviatilis* BL. Bijdr. (1826) 1132. — Fig. 5.

Herb with prostrate or ascending stems, rooting at the nodes, with conspicuous white, erect, spindle-shaped, mucronate aerophores arising in clusters at the nodes of the floating stems and from the roots, the more or less erect stems to 60 cm; floating stems to 4 m; plants normally glabrous, but the branches growing on dry ground densely

villous and rarely flowering. *Leaves* broadly oblong-elliptical, 0.4-7 by 0.7-4 cm, narrowly cuneate at base, apex acute or obtuse; nerves 6-13 pairs; submarginal vein not prominent; petioles long. *Flowers* in upper leaf axils. *Bracteoles* present near base of capsule, deltoid, c. 1.2 by 1.3-1.5 mm. *Sepals* 5, deltoid-acuminate, 5-11 by 2-3.2 mm, glabrous or villous. *Petals* creamy white, yellow at base, obovate, rounded at apex, 9-18 by 6-10 mm. *Stamens* 10, epipetalous ones slightly shorter; filaments white, 2.5-4 mm; anthers 1.2-1.8 mm long, apparently shedding pollen directly on the stigma at anthesis. Pollen grains shed singly. Disk \pm elevated, with a depressed white-hairy nectary surrounding the base of each epipetalous stamen. *Style* white, 4-8 mm, densely long-hairy in lower half; stigma globose, green, 1.5-2 mm \varnothing , 1-1.2 mm high, the upper $\frac{2}{3}$ receptive. *Capsule* glabrous or villous, 1.2-2.7 cm by



Fig. 5. *Ludwigia adscendens* (L.) HARA, $\times \frac{2}{3}$ (after BACKER, 1940).

3–4 mm, light brown, with 10 conspicuous darker brown ribs, terete, the seeds evident between the ribs as bumps c. 1.5 mm apart; capsule thick-walled, very tardily and irregularly dehiscent; pedicel 2.5–5.5 cm. *Seeds* uniseriate in each cell of the capsule, pale brown, 1.1–1.3 mm long, \pm vertical, firmly embedded in coherent cubes of woody endocarp 1.2–1.5 mm high, 1–1.2 mm thick, the endocarp firmly fused to the capsule wall.

Gametic chromosome numbers, $n = 8, 16$.

Distr. Continental Asia (from Ceylon to S. China), throughout *Malesia*, in Australia one locality in W. Arnhem Land. Fig. 6.

Ecol. Freshwater pools, ditches, swamps, fallow and wet paddies, very common, from the lowland up to c. 1600 m. *Fl.* Jan.–Dec.

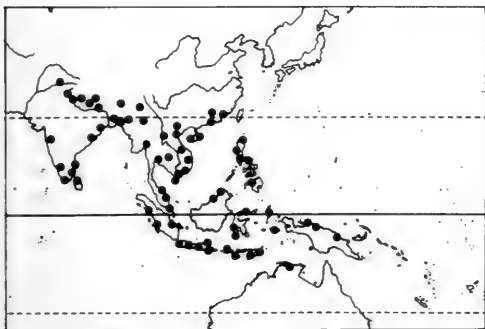


Fig. 6. Range of *Ludwigia adscendens* (L.) HARA (after RAVEN, 1963).

BACKER (*Trop. Natuur* 3, 1914, 56) depicted and described in detail the biology. The root system consists of three kinds, long \pm unbranched anchor roots, shorter much-branched feeding roots, and the erect spongy aerophores. BACKER cut the latter, but the plant remained (only very slightly less) buoyant. After pollination the pedicel bends down and the fruit ripens in the water (as in several other aquatics); the fruit decays and releases the cork-winged seeds which are buoyant.

On desiccated muddy soils a never-flowering terrestrial form often occurs, marked by very small crowded leaves and a stronger pubescence.

Uses. Malays in Perak use it for poulticing in skin complaints (BURKILL, *Dict.* 1935, 1273). Batak people use this (and other aquatics, like also do the Chinese) to feed pigs, and it is recorded to be eaten as salad in Indo-China. QUISUMBING (*Medic. Pl. Philip.* 1951, 677) reported that it is used in a decoction as an astringent for dysentery.

Vern. *Water primrose*, E; Sumatra: *buang buang*, Toba-Batak; Java: *pangeor*, M, *ganggèng landeuj*, *kambang peutjit*, *rubu silah*, (*rumpu*) *kologa*, S, *krangkong*, *krèma*, *patjar banju*, *tapak doro*, J; Philippines: *sigang-dagat*, Tag., *gabi-gabi*, Mag., *tabagan*, If.; New Guinea: *agidahan*, Kutubu lang.

Note. *L. adscendens* appears to be allied more closely to the American *L. helminthorrhiza* (MART.) HARA than to any Old World species. Together with the mostly yellow-flowered African *L. stolonifera* (GUILL. & PERR.) RAVEN, these three are the only species that regularly produce clusters of erect inflated aerophores at the floating nodes, although other species have descending root-like aerophores at these nodes and may have long, spongy aerophores from the submerged underground parts.

Excluded or Doubtful

Jussiaea tenella BURM. f. *Fl. Ind.* (1768) 103, t. 34, f. 2.

There is no unanimity of opinion about the identity of BURMAN's plant which he said to have come from Java. MERRILL (*Philip. J. Sc.* 19, 1921, 369) suggested it to be a form of *L. octovalvis* which I doubt in view of the specific epithet and the species with which it is being contrasted. ALSTON (*in Trimen, Fl. Ceyl.* 6, 1931, 130) took it up for *L. hyssopifolia*, and this suggestion seems the most plausible. From BURMAN's description, which contains almost certainly errors, it cannot be identified. Unfortunately, or perhaps fortunately, the type at G could not be found.

Ludwigia erigata LINNÉ, *Mantissa* 1 (1767) 40. — *L. triflora* DESR. in Lamk, *Encycl.* 3 (1792) 615, *nom. illeg. subs.*, belongs to the *Rubiaceae*.

Ludwigia trifolia BURM. f. *Fl. Ind.* (1768) 36; HOUTT. *Nat. Hist.* 2, 7 (1777) 344 is according to MERRILL (*J. Arn. Arb.* 19, 1939, 368) *Oldenlandia biflora* L. (*Rubiaceae*).

2. EPILOBIUM

LINNÉ, *Gen. Pl.* ed. 5 (1754) 164; *Sp. Pl.* 1 (1753) 347; HAUSSKNECHT, *Monogr. Epilob.* (1884); RAVEN, *Bull. Br. Mus. Nat. Hist. Bot.* 2 (1962) 325, 13 maps, pl. 33–39; BROCKIE, *New Zeal. J. Bot.* 4 (1966) 366, 2 fig.; *Bothalia* 9 (1967) 309, 7 fig.; RAVEN, *Blumea* 15 (1967) 269, 7 fig.; BROCKIE, *New Zeal. J. Bot.* 8 (1970) 94; RAVEN, *D.S.I.R. New Zeal. Bull.* 216 (1976) 321 pp., 158 fig. — Fig. 7.

Perennial herbs, often flowering in the first year, occasionally somewhat woody near the base. *Leaves* (in Mal.) opposite below, spirally arranged above. *Flowers* in the axils of the often greatly reduced upper leaves. Floral tube short (in Mal.) or essentially absent. *Sepals* 4, erect. *Petals* 4, white, pink, or purple, emarginate

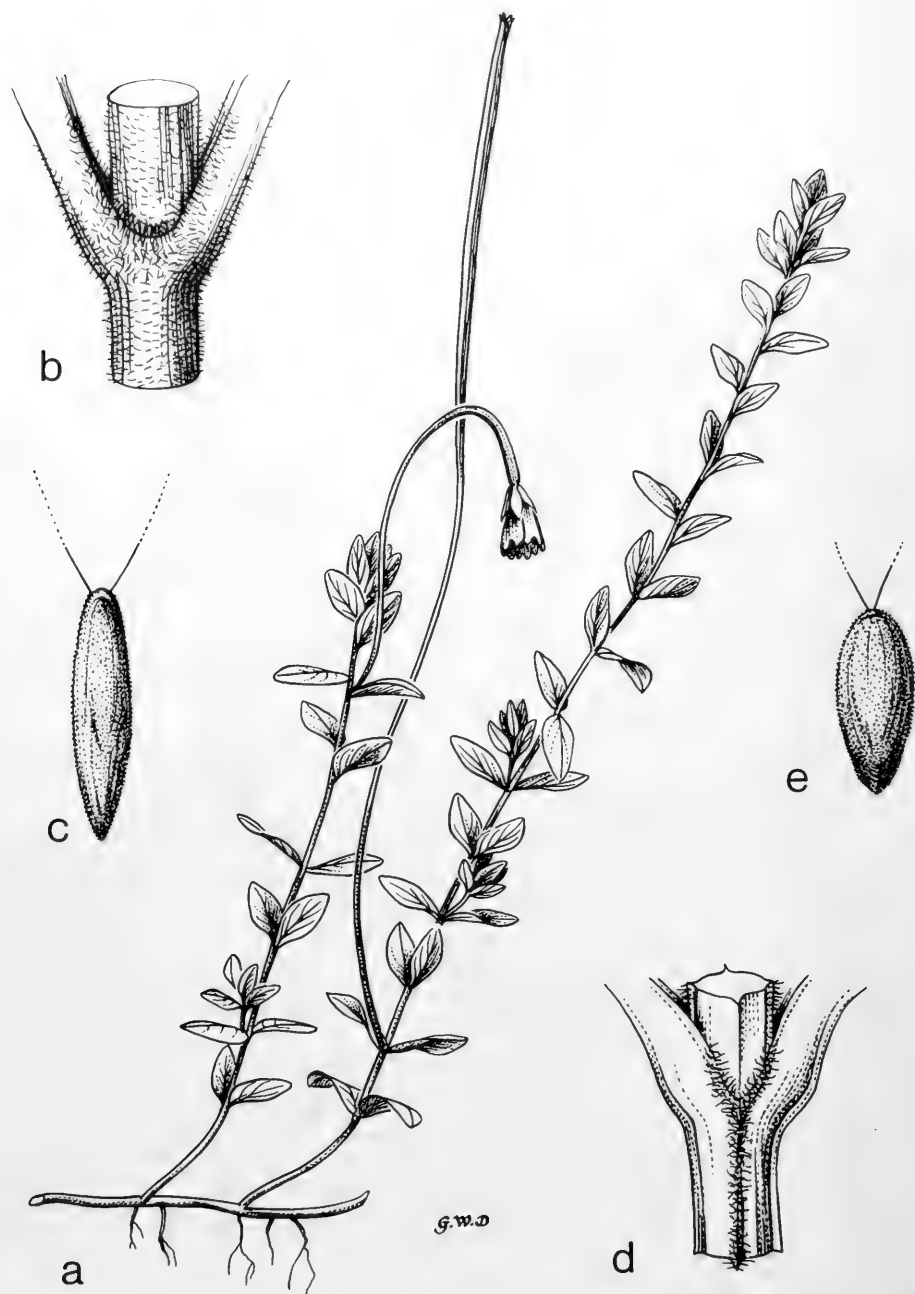


Fig. 7. *Epilobium hooglandii* RAVEN. a. Habit, nat. size, b. node, $\times 10$, c. seed with base of coma, $\times 30$. — *E. detznerianum* SCHLTR ex DIELS. d. Node, $\times 10$. — *E. prostratum* WARB. e. Seed, $\times 30$ (a-c HOOGLAND & PULLEN 5540, d HOOGLAND & PULLEN 5687, e WOMERSLEY c.s. 6103). After Raven, 1967.

(in Mal.). *Stamens* 8, in 2 whorls, the epipetalous ones shorter. *Stigma* (in Mal.) clavate or rarely globose, usually surrounded by the shedding anthers at maturity. *Ovary* 4-locular, the ovules very numerous. *Fruit* a long, slender, loculicidal capsule. *Seeds* very numerous, small, with a chalazal plume of trichomes (coma).

Distr. About 200 *ssp.*, well-represented in temperate regions, mostly on the northern hemisphere, with the greatest centre of morphological diversity in the western U.S.A., at relatively high latitudes and altitudes; in the tropics confined to the mountains; in *Malesia*: rare and local, in W. Central Sumatra, E. Java (Mt Tengger), Lesser Sunda Is. (Lombok, Sumbawa, Timor), Philippines (N. Luzon, Panay), SW. Central Celebes (Latimodjong Range), Moluccas (Central Ceram), and New Guinea.

Ecol. Characteristic of open, disturbed habitats or grassland or the alpine zone, not normally found in primary forest.

Dispersal takes easily place by wind as the light seeds are provided with a silky coma.

It is still rather surprising that, whereas open habitats are very common in the Malesian mountains, with their numerous volcanoes and alpine habitats, the number of localities is so very restricted. It must probably be considered that though dispersal may be easy, the coma only acts efficiently in dry air and this is in the tropics with their frequent rain and cloud formation and nightly fogs during most of the year a rather rare climatic situation. In this respect the west-monsoon, blowing from Asia southeastwards (Nov.–March) is most unsuitable, as these winds are laden with moisture. The east-monsoon, blowing from Australia northeastwards (May–Sept.) is in this respect definitely more favourable as this is a dry wind. This wind regime is a consequence of the situation of the Asian and Australian continents.

Local dispersal by water might also occur, as the lowest localities in New Guinea are all along stream-sides, but this may also be due to the downward air-stream over rushing water.

For hybridization see under the family.

Genesis. The species occurring in Sumatra (1 *sp.*) and in Luzon (2 *ssp.*) also occur in continental SE. Asia, the one in E. Java and the Lesser Sunda Is. (*E. hirtigerum*) also occurs in Australia, Tasmania, and New Zealand. The four remaining species are all endemic in East Malesia, 3 being confined to New Guinea and 1 also occurring in Central Celebes and Ceram. They are closely related to species found in Australia and New Zealand, from which they, and *E. hirtigerum*, were probably derived *via* the east-monsoon discussed above.

I have argued that the Australasian species ultimately show affinity to those of continental Asia and their ancestors must have reached Australia across the tropical mountains of Malesia. My assumption is that this southeastward penetration of the genus occurred in the Pliocene.

KEY TO THE SPECIES

1. Buds and flowers erect, the inflorescence erect or somewhat drooping.
 2. Stems pubescent only along conspicuously elevated lines running down from the margins of the petioles. 3. *E. wallichianum*
 2. Stems pubescent all around.
 3. Upper leaves strongly reduced. Inflorescence slightly nodding (Luzon).
 4. Leaves ovate, 0.4–1.5 cm wide 1. *E. brevifolium*
 4. Leaves very narrowly elliptic to linear, 0.1–0.5 cm wide. 2. *E. platystigmatosum*
 3. Upper leaves not notably reduced. Inflorescence erect (Java, Lesser Sunda Is., New Guinea).
 5. Plants finely glandular-pubescent; leaves usually ericoid in appearance; petals purplish-rose 5. *E. keysseri*
 5. Plants densely strigulose; leaves broader, not ericoid; petals white or very pale pink 4. *E. hirtigerum*
1. Buds and flowers drooping, becoming erect in fruit.
 6. Stems with elevated glabrous lines running from the center of each petiole and elevated pubescent lines from their angles; petals 7–14 mm long 6. *E. detznerianum*
 6. Stems without elevated lines, uniformly pubescent all around; petals 2.5–8.5 mm long.
 7. Petals 6–8.5 mm long; seeds 1–1.4 mm long 7. *E. hooglandii*
 7. Petals 2.5–5(–6) mm long; seeds 0.7–0.9 mm long. 8. *E. prostratum*

1. *Epilobium brevifolium* D. DON, Prod. Fl. Nepal. (1825) 222; RAVEN, Bull. Br. Mus. Nat. Hist. Bot. 2 (1962) 361.

ssp. trichoneurum (HAUSSKNECHT) RAVEN, Bull. Br. Mus. Nat. Hist. Bot. 2 (1962) 362. — *E. trichoneurum* HAUSSKNECHT, Oest. Bot. Z. 29 (1879) 54; Monogr. Epilob. (1884) 208; H. LÉVEILLÉ, Ic. Gen. Epilob. (1910) t. 84. — *E. philippinense* C.B. ROB. Philip. J. Sc. 3 (1908) Bot. 209; MERR. En. Philip. 3 (1923) 220, excl. syn.

Robust, perennial herb, 15–40 cm, the underground parts not scaly; plants strigulose, stems pubescent all around. *Leaves* mostly opposite, alternate in and near the inflorescence, the upper ones reduced, strigulose along the veins and margins especially below, the nerves evident, ovate, 1–3 by 0.4–1.5 cm, serrate; petiole 1–2 mm. Inflorescence slightly nodding. *Flowers* erect, borne in the axils of reduced upper leaves. Floral tube 1.8–2.4 mm across, 1–1.3 mm deep. *Sepals* 2.5–5.5 by 1–1.3 mm. *Petals* obovate, 4.5–8 by 3–5.5 mm,

rose purple, the notch 1–1.5 mm deep. *Anthers* 1–1.2 mm long; filaments of the longer stamens 1.2–2.5 mm, those of the shorter 1–1.5 mm. *Style* 2.5–4 mm. *Stigma* clavate, 1.8–2.3 mm high, c. 1 mm thick, surrounded by the anthers at anthesis. *Capsule* 3.5–7 cm long, on a pedicel 0–1 cm. *Seeds* 0.9–1.2 by 0.4–0.5 mm, papillose, blackish brown, not beaked, obovoid, blunt at both ends, the coma 5–7 mm long, white.

Gametic chromosome number, $n = 18$.

Distr. Continental SE. Asia (SE. Tibet: Chumbi Valley, to Assam, Burma, and W. China); in *Malesia*: Philippines (Mountain Province of N. Luzon).

Ecol. Wet open slopes in the pine region, along streams and by springs, 1400–2100 m. *Fl.* July, Oct.

Note. *E. brevifolium* ssp. *trichoneurum* is one of three subspecies of a species which ranges from Himachal Pradesh in the Western Himalaya eastwards throughout the Himalaya and southern China to Formosa, northern Luzon, northern Vietnam, and northern Burma. In northern Luzon, it occurs together with the other species found in the Philippines, *E. platystigmatosum*, and one plant of the collection CLEMENS 16385, suggests hybridization between these two entities, which are usually widely distinct morphologically, although doubtless more closely related to one another than to other Malesian species.

2. *Epilobium platystigmatosum* C. B. ROBINSON, Philip. J. Sc. 3 (1908) Bot. 210; MERR. En. Philip. 3 (1923) 221; RAVEN, *Blumea* 15 (1967) 272. — *E. cephalostigma* var. *linearifolium* HISAUTI, J. Jap. Bot. 14 (1938) 143, f. 3. — *E. formosanum* MASUM. Trans. Nat. Hist. Soc. Formosa 29 (1939) 62; OHWI, Fl. Japan (1965) 657. — *E. sohayakiense* KOIDZ. Act. Phytotax. Geobot. 8 (1939) 61.

Slender, perennial herb, 15–40 cm tall, the underground parts not scaly; plants strigulose, densely so in the inflorescence, the stems pubescent all around. *Leaves* mostly opposite, alternate in and near the inflorescence, the upper ones reduced, strigulose along the veins and margins especially below, the nerves evident, very narrowly elliptic or linear, 1–3(–4) by 0.1–0.5 cm, weakly and sparsely serrulate; petiole 1–4 mm. Inflorescence slightly nodding. *Flowers* erect, borne in the axils of reduced upper leaves. Floral tube c. 1 mm across, c. 0.8 mm deep. *Sepals* 3–4 by 1.2–1.6 mm. *Petals* narrowly obovate, 3.3–4.5 by c. 2 mm, white or pale pink, the notch c. 1 mm deep. *Anthers* 0.2–0.3 mm long; filaments of the longer stamens c. 1.8 mm, those of the shorter c. 1.2 mm. *Style* c. 2 mm. *Stigma* broadly clavate, c. 0.8 mm high, c. 0.4 mm thick, surrounded by the anthers at anthesis. *Capsule* glabrescent, 3–5 cm long, on a pedicel 0–1.8 cm. *Seeds* 0.8–1 by 0.3–0.4 mm, papillose, not beaked, obovoid, blunt at both ends, the coma 4–6 mm long, white.

Gametic chromosome number, $n = 18$.

Distr. Japan, China (Hupei, Kiangsu), Formosa, and *Malesia*: Philippines (N. Luzon: Benguet Prov.; Panay: BS 31439).

Ecol. Chiefly along small streams and about cliffs, 1200–2400 m. *Fl.* April–June.

Note. I can find no difference between the species generally known as *E. formosanum* and the supposed Philippine endemic populations of *E. philip-*

pinense. This species is apparently not common on the Asian mainland.

3. *Epilobium wallichianum* HAUSSKNECHT, Oest. Bot. Z. 29 (1879) 54; RAVEN, Bull. Br. Mus. Nat. Hist. Bot. 2 (1962) 365; *Blumea* 15 (1967) 272. — *E. nepalense* HAUSSKNECHT, Oest. Bot. Z. 29 (1879) 53, p.p.; Monogr. Epilob. (1884) 218, p.p.; H. LÉVEILLÉ, Ic. Gen. Epilob. (1910) t. 120. — *E. duclouxii* H. LÉVEILLÉ in Fedde, Rep. 6 (1908) 110; Ic. Gen. Epilob. (1910) t. 144. — *E. sarmentaceum* (non HAUSSKNECHT) BÜNNEMEIJER, Trop. Natuur 10 (1921) 57, f. 9.

Erect perennial herb 15–50 cm, from a long rhizomatous base from which leafy shoots arise; plants strigulose, more densely so above, with elevated pubescent lines running down from the sides of the petioles, stems thick and hollow. *Leaves* opposite in lower half of the plant, alternate above, the margin and nerves densely strigulose, narrowly ovate or lanceolate, subacute at the apex, obtuse at the base, sharply and densely serrulate, 1.5–4 by 0.5–1.5 cm; petiole short but distinct, up to 2 mm. Inflorescence densely strigulose with an admixture of glandular trichomes, somewhat nodding in bud. Floral tube c. 2 mm across, c. 0.8 mm deep. *Sepals* c. 5 by c. 2 mm, apiculate. *Petals* obovate, c. 8 by 3.5–4 mm, pale violet, the notch shallow, c. 1 mm deep. *Anthers* 1.3–1.5 mm long; filaments of the longer stamens c. 2 mm, those of the shorter c. 1 mm. *Style* 3–3.5 mm. *Stigma* globose, c. 1.5 mm thick, surrounded by the anthers at anthesis. *Capsule* densely strigulose with an admixture of erect, glandular trichomes, erect, 5–9.5 cm long, on a pedicel 1–2 cm. *Seeds* 1.2 by 0.6 mm, coarsely papillose, dark brown, the coma 6–7 mm long, white, tinged with brown at the base.

Distr. Continental SE. Asia (W. Nepal to Yunnan, south to the Khasya & Naga Hills), in *Malesia*: Central W. Sumatra (Mt Kerintji), one collection.

Ecol. Along river-bank, c. 2000 m.

4. *Epilobium hirtigerum* A. CUNN. Ann. Mag. Nat. Hist. 3 (1839) 33; HAUSSKNECHT, Monogr. Epilob. (1884) 291; H. LÉVEILLÉ, Ic. Gen. Epilob. (1910) t. 18; ALLAN, Fl. New Zeal. 1. (1961) 279; BURBIDGE & GRAY, Fl. A.C.T. (1970) 276; WILLIS Handb. Pl. Vict. 2 (1972) 464; RAVEN, D.S.I.R. New Zeal. Bull. 216 (1976) 141, f. 63–64, 65–66 (maps). — *E. brasiliense* HAUSSKNECHT, Oest. Bot. Z. 29 (1879) 119. — *E. sarmentaceum* (non HAUSSKNECHT) KOORD. Exk. Fl. Java 2 (1912) 704; BACK & BAKH, f. Fl. Java 1 (1963) 262. — *E. cinereum* (non A. RICH.) RAVEN, *Blumea* 15 (1967) 273, *pro specim. mal.*

Robust, erect, clumped perennial herb, 15–100 cm, the underground parts not scaly; plants densely strigulose, the stems pubescent all around. Lowermost leaves opposite, the rest alternate, densely strigulose, especially below and along the veins, nerves evident, narrowly lanceolate, 0.6–3 by 0.2–0.5 cm, coarsely serrate, subsessile. Inflorescence erect. *Flowers* erect, borne in the axils of upper leaves. Floral tube c. 1 mm across, c. 1 mm deep. *Sepals* 3–5.5 by 0.8–1.6 mm. *Petals* obovate, 3–5 by 2–3.2 mm, white or very pale pink, the notch c. 1 mm deep. *Anthers* 0.7–1 mm long;

filaments of the longer stamens 2–2.8 mm, those of the shorter 1–1.8 mm. *Style* 1–3 mm. *Stigma* clavate, 1.5–2.7 mm high, 1–1.5 mm thick, surrounded by the anthers of anthesis. *Capsule* 3–5(–6) cm long, on a pedicel 0–2 cm. *Seeds* 0.9–1.2 mm long, 0.35–0.45 mm thick, finely papillose, brown, not beaked, obovoid, blunt at both ends, the coma 5–8 mm long, white.

Gametic chromosome number, $n = 18$.

Distr. Very widely distributed, South America (Argentina, Uruguay, Brazil: Santa Catarina), New Zealand, Australia, and *Malesia*: Lesser Sunda Is. (Timor, Sumbawa, Lombok) and East Java (Mt Tengger).

Ecol. Moist places, grasslands; in E. Java the only locality is near the single small well on the otherwise dry and barren extinct volcanic cone of Mt Widodaren on Mt Tengger caldera, at 2100 m. In Lombok in *Casuarina* forest; in Timor in Eucalypt savannah; 1800–2200 m. *Fl.* Oct.–Jan.

Note. Variable species. The Malesian specimens belong to a highly autogamous Australian form with small white flowers which occurs in swampy places throughout the lowlands of Australia (from Queensland to temperate W. Australia and Tasmania) and is predominant in New Zealand. I have assumed that it came there from Australia and has spread again from New Zealand to South America, either by natural dispersal or by man.

5. *Epilobium keysseri* DIELS, Bot. Jahrb. 62 (1929) 486; HOOGL. *Blumea* Suppl. 4 (1958) 223; BORG-MANN, Z. Bot. 52 (1964) 124, 143; RAVEN, *Blumea* 15 (1967) 274, f. 1 (map).

Clumped erect perennial herb 12–60 cm, often ericoid in aspect, \pm woody at the base, the underground parts not scaly; plants finely glandular-pubescent. Lowermost *leaves* opposite, the rest alternate, coriaceous, subglabrous, the nerves obscure, margin revolute, narrowly elliptic to elliptic, 0.5–1.3 by 0.1–0.2(–0.4) cm, with a few coarse teeth on each side, subsessile. Inflorescence erect. *Flowers* erect, borne in axils of upper leaves. Floral tube 1–2 mm across, 0.7–1 mm deep. *Sepals* 3–5.6 by 1–2.5 mm. *Petals* obovate, 4.5–8 by 2.8–4 mm, purplish rose, the notch 1.5–2 mm deep. *Antthers* 0.7–1 mm long; filaments of the longer stamens 1.8–2.5 mm, those of the shorter 0.5–1.5 mm. *Style* 2.5–4 mm. *Stigma* clavate, 1.5–2 mm high, 0.5–0.7 mm thick, surrounded by the anthers at anthesis. *Capsule* 3–6 cm long, glabrescent, on a pedicel 1–2.5 cm. *Seeds* 0.9–1.2 by 0.4–0.6 mm, papillose, brown, with a short pellucid beak, the coma 5–7 mm long, white.

Gametic chromosome number, $n = 18$.

Distr. *Malesia*: New Guinea (Mt Wilhelm in West, common on many summits in East), many collections. Fig. 8.

Ecol. Subalpine and alpine meadows and grasslands, open shrubberies, swampy treefern grassland, occasionally epiphytic on treefern trunks, forest glades, often in succession after ground-fires, (1600–)1950–3800 m. *Fl.* (Jan.–)June–Aug.(–Dec.).

Vern. *Aingum*, Tomba, gonema, Chimbu, *yandepai*, Enga lang., Wabag, *papai*, Enga lang., Poio, *tamtan*, Mendi lang., Giluwe.

Notes. A distinctive species but clearly belonging to the Australasian assemblage.

Most plants, with their narrow leaves, are dis-

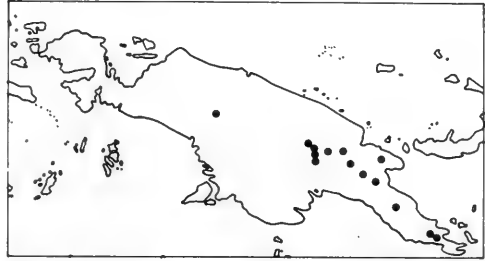


Fig. 8. Range of *Epilobium keysseri* DIELS (after RAVEN, 1967).

tinctly ericoid in appearance, and thus parallel representatives of many other typically non-ericoid groups that occur in alpine and subalpine regions of New Guinea.

6. *Epilobium detznerianum* SCHLTR ex DIELS, Bot. Jahrb. 62 (1929) 485; RAVEN, *Blumea* 15 (1967) 277, f. 3, 5 (map). — *E. papuanum* RIDL. var. *alpestre* RIDL. Trans. Linn. Soc. Bot. II, 9 (1916) 58. — *E. papuanum* (non RIDL.) HOOGL. *Blumea* Suppl. 4 (1958) 228. — Fig. 7d.

Clumped perennial herb 3–15 cm, the underground stems not scaly; plants mostly glabrous, with elevated, strigulose lines running down from the margins of the petioles and glabrous ridges running down from back of petioles. *Leaves* mostly opposite, alternate in the inflorescence, coriaceous, nerves obscure, broadly elliptic or ovate, obtuse at apex and base, entire, 0.3–1 by 0.2–0.7 cm; petiole 1–1.5 mm, short but distinct. *Flowers* nodding, the ovaries erect, borne in the axils of upper leaves. Floral tube 1.5–3 mm across and about as deep. *Sepals* 4.5–7 by 1–2.5 mm. *Petals* obovate, 7–14 by 3–6 mm, bright purplish rose, the notch c. 2 mm deep. *Antthers* 0.8–1.2 mm long; filaments of the longer stamens 4–5.5 mm, those of the shorter 3.3–4.5 mm. *Style* 5.5–8 mm. *Stigma* broadly clavate, 1.3–1.7 mm high, c. 1 mm thick, surrounded by or held just above the anthers at anthesis. *Capsule* erect, subglabrous, 4–5 cm long, on a pedicel 2.5–8.5 cm. *Seeds* (0.9–)1–1.5 by 0.5–0.7 mm, not beaked, finely papillose, pale brown, the coma c. 8 mm long.

Gametic chromosome number, $n = 18$.

Distr. *Malesia*: New Guinea (Mts Carstensz & Wilhelmina in West, Telefomin, Mts Sarawaket & Wilhelm in East). Fig. 9.

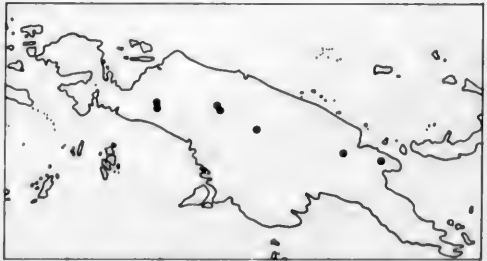


Fig. 9. Range of *Epilobium detznerianum* SCHLTR ex DIELS (after RAVEN, 1967).

Ecol. Subalpine and alpine grasslands and ridges, open slopes and bogs, earth screes, sub-alpine forest and its grassy edges, rock clefts, cliff crevices in alpine thickets, on dripping slate landslides, more rarely on sandy or gravelly gully beds; 3000–4500 m. *Fl.* (Jan.–Febr.–)May–Sept. (–Dec.).

Note. An attractive alpine species reaching the highest elevations in the genus in New Guinea. It is usually more condensed in habit than *E. hooglandii* and differs at once from that species in the glabrous ridge decurrent from the center of each petiole and the elevated pubescent lines decurrent from the edges of the petiole. It grows sympatrically with *E. hooglandii* and *E. keysseri*, but no intermediates have been observed; intermediates with the former species would be very difficult to detect.

7. *Epilobium hooglandii* RAVEN, *Blumea* 15 (1976) 278, f. 2, 6 (map). — *E. pedunculare* (non A. CUNN.) F.v.M. Trans. R. Soc. Vict. 1, 2 (1889) 7. — *E. detznerianum* (non SCHLTR ex DIELS) HOOGL. *Blumea* Suppl. 4 (1958) 228. — **Fig. 7a–c.**

Caespitose perennial herb with decumbent branches, the erect portions 10–25(–45) cm long; plants glandular pubescent along elevated lines running down from the margins of the petioles below, more densely and uniformly so above, and with an admixture of strigulose pubescence in the inflorescence. *Leaves* mostly opposite, alternate in the inflorescence, subcoriaceous, nerves \pm visible in dried material, broadly elliptic to ovate, acute or obtuse at apex and base, entire or with a few teeth on the margins, 0.5–1.3 by 0.3–0.9 cm; petiole 1–3 mm, short but distinct. *Flowers* nodding, the ovaries erect, borne in the axils of upper leaves. *Floral tube* 1.4–2 mm across, 1–1.2 mm deep. *Sepals* 3–4 by 1–1.6 mm. *Petals* 6–8.5 by 2.5–4.5 mm, pink to purplish rose, the notch c. 1.5 mm deep. *Anthers* 0.7–1 mm long; filaments of the longer stamens 3–6 mm, those of the shorter 2–4 mm. *Style* 2.5–6 mm. *Stigma* clavate, 2–2.5 mm long, 1–1.2 mm thick, surrounded by the anthers at anthesis. *Capsule* erect, glabrescent, 5–8 cm long, on a pedicel 4–12 cm. *Seeds* 1–1.4 by 0.3–0.45 mm, finely papillose, brown; coma 5–8 mm long, white.

Gametic chromosome number, $n = 18$.

Distr. Malesia: New Guinea (Mt Wilhelmina in West, many localities in East).

Ecol. Subalpine and alpine meadows, fire-induced alpine grassland, near boulders, in alpine shrubbery, on peaty grassland, near waterfalls, in secondary forest on limestone cliffs, on stream-bank gravel, stony creek beds, along forest tracks, between grass tussocks in old lake basin, in pendent masses on rocks, occasionally in moist, forested areas; 2000–4150 m. *Fl.* May–Nov. (–Jan.).

Vern. *Dirimpia*, Chimbu, Masul, *nonami*, Mairi, Mondo.

Note. Differs from the closely related *E. detznerianum* by its evenly pubescent stems, and

from *E. prostratum* by large flowers and seeds. It grows sympatrically with the other three New Guinean species. Occasional collections are intermediate with *E. prostratum* and obviously result from incidental hybridization. However, the two species keep in general amply distinct and are as well differentiated as most recognized species of the genus.

8. *Epilobium prostratum* WARB. Bot. Jahrb. 16 (1893) 15, 23; RAVEN, *Blumea* 15 (1967) 280, f. 4, 7 (map). — *E. papuanum* RIDL. Trans. Linn. Soc. Bot. II, 9 (1916) 57. — **Fig. 7e.**

Similar to *E. hooglandii*, but differing as follows: habit lax, spreading. *Leaves* 0.4–0.8 by 0.2–0.4 cm. *Floral tube* 0.8–1.1 mm across, 0.6–0.9 mm deep. *Sepals* 1.5–3 by 0.6–1.4 mm. *Petals* 2.5–5(–6) by 1.3–2.5 mm, very pale pink to purplish rose, the notch c. 1 mm deep. *Anthers* 0.5–0.7 mm long; filaments 1.8–3.5 mm. *Stigma* clavate, 0.8–1.5 mm long, 0.5–0.9 mm thick, surrounded by the anthers at anthesis. *Capsule* 3.5–5 cm long, on a pedicel 5–10 cm. *Seeds* 0.7–0.9 by c. 0.3–0.4 mm, finely papillose, brown, the coma 5–8 mm long.

Gametic chromosome number, $n = 18$.

Distr. Malesia: SW. Central Celebes (Latimodjong Mts), Moluccas (Ceram), and throughout New Guinea. **Fig. 10.**

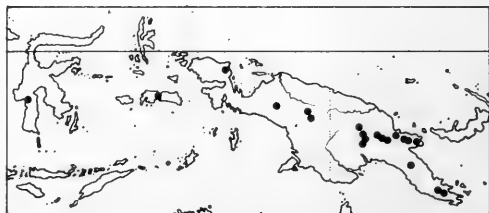


Fig. 10. Range of *Epilobium prostratum* WARB.

Ecol. Moist open places, especially on rocky alluvium bordering streams, stream-banks across treefern grassland, along river-bank in limestone scree, on fallen trees on open ridge, rarely in montane forest, sometimes colonizing landslips; (1200–)1900–3400 m, in Celebes and Ceram at c. 2750–3400 m. *Fl.* Jan.–Dec.

WARBURG's type specimen was found by HELDWIG at an exceptional low altitude of 1200 m in a streambed.

Vern. New Guinea: *kimbil*, Enga lang., *Poio*, *dirimpia*, Chimbu, Masul, *kokorabadi*, Mandi lang.

Notes. Closely similar to *E. hooglandii*, but readily distinguished for the most part by smaller flowers and seeds. Occasionally intermediate specimens (obviously hybrids) are found where the two occur together.

In New Guinea it descends to lower altitudes and has correspondingly a much wider range.

Introduced

Fuchsia boliviana CARR. Rev. Hort. (1876) 150; as *F. corymbiflora* (non R. & P.) BACK. & BAKH. f. *Fl.* Java 1 (1963) 264.

Locally cultivated and perhaps established in the mountains of West and East Java (Mts Malabar and Tengger) between 1500 and 2000 m.

Easily distinguished from the following species by its drooping inflorescences of bright red flowers with a floral tube 5–6 (instead of less than 1) cm long.

Fuchsia magellanica LAMK var. *gracilis* (NICH.) BAILEY: BACK. & BAKH. f. Fl. Java 1 (1963) 264; as *F. coccinea* (non SOL. ex AITON) CURT. — BÜNNEMEIJER, Trop. Natuur 10 (1921) 56, fig.; WISSE, *ibid.* 11 (1922) 480, fig.; HOCHR. Candollea 2 (1925) 480; BACK. & BAKH. f. Fl. Java 1 (1963) 264.

This species, native of temperate South America, has repeatedly been reported to occur cultivated but also naturalized in anthropogenous places and on volcanic ash on the mountains of West, Central, and East Java (Mts Patuha, Malabar, Diëng, Sindoro, and Tengger) between 1000 and 2100 m, and in the mountains of Sumatra (Karo Lands).

Oenothera stricta LEDEB. ex LINK, En. Hort. Berol. 1 (1822) 377, *ssp. stricta*; as *O. erythrosepala* (non BORBÁS) BACK. & BAKH. f. Fl. Java 1 (1963) 262. — *Oenothera sp.* DOCT.V. LEEUWEN, Verh. Kon. Ak. Wet. A'dam II, 31 (1933) 191.

DOCTERS VAN LEEUWEN l.c. introduced this species from seed he collected in Hawaii and sowed on the summit of Mt Pangrango in West Java, at 3000 m altitude, in 1921. It is maintaining itself there and, although self-pollinating, is visited by *Bombus rufipes* (HEIDE, Dansk Bot. Ark. 5, 1927, 18) and doubtless by nocturnal insects as well. It is a native of temperate South America, widely cultivated and naturalized.

It may be distinguished from all other species of the family in Malesia by its combination of a long floral tube and yellow petals; the flowers open at sunset.

Cultivated

Representatives of several genera — *Clarkia* and *Gaura* among them — are cultivated, mainly in the mountains. BACKER & BAKHUIZEN VAN DEN BRINK f., Fl. Java 1 (1963) gave an account of these.

BIGNONIACEAE (C. G. G. J. van Steenis, Leyden)

Trees, shrubs, lianas, very rarely herbaceous (*extra-Mal.*); twigs often lenticellate and nodes with gland fields; spines very rare (*extra-Mal.*). Stipules absent. *Leaves* simple or mostly compound (digitate or impari-1-4-pinnate), (in *Mal.*) decussate, rarely in whorls of 3-4, often provided with glands underneath, in the New World often provided with terminal tendrils, rarely scattered or in pseudo-whorls (*extra-Mal.*); domatia sometimes present (fig. 8b, 23h). *Inflorescences* bracteate, cymose, but not rarely thyrses contracted to racemiform or racemose inflorescences, or even reduced to solitary flowers (*extra-Mal.*), terminal, axillary or from the old wood. Pedicels mostly with 1-2 bracteoles. *Flowers* usually very showy, rather large, bisexual, articulate with the pedicel or not. *Calyx* connate, closed in bud and later (not rarely irregularly) splitting into lobes, or cupular, or spathaceous, or lobed from the beginning and with equal or unequal, valvate lobes, developing earlier than the corolla, often glandular outside and inside with water and slime producing glands and hydathodes, persistent or circumscissile caducous along an abscission line. *Corolla* sympetalous, campanulate, tubular, funnel- or salver-shaped, mostly zygomorphic, lobes equal or unequal, valvate or imbricate in bud, tube often with a narrow cylindrical (constricted) lower part (basal tube) and a widened upper part (upper tube). *Stamens* 5 almost equal, or mostly 4 didynamous, the 5th sterile, rudimentary, adnate to the corolla tube, mostly inserted at the rim of the basal tube and not rarely (glandular) hairy at the insertion, more rarely inserted higher up. *Anthers* basifixed, 2-celled, rarely one cell barren or 1-celled, introrse, dehiscing lengthwise, usually the anthers connivent in pairs; anther cells often free and divergent, connective not rarely produced. *Disk* intrastaminal, mostly annular, rarely absent. *Ovary* superior, 2-celled, rarely 1- or 4-celled (*extra-Mal.*); style filiform, stigma usually 2-lipped, sensitive. *Ovules* (in *Mal.*) in each cell on the septum in two or more rows of 3- ∞ , mostly on 2 placentas. *Capsule* 2-valved, either loculicid with the septum perpendicular to the valves — sometimes provided with an additional transverse false septum — or septicid with the septum parallel with the valves, or (*extra-Mal.*) an indehiscent, 1-celled, soft or hard-shelled, pulpy berry. *Seeds* in each cell attached to the dissepiment in one or more rows, inserted transverse to axis of fruit, anatropous, mostly on both sides with hyaline wings; *embryo* exalbuminous, the cotyledons mostly notched, sometimes on both sides. Germination always epigeal.

Distribution. About 120 genera and some 650 *spp.*, mainly in the tropics and subtropics, roughly between 40° N and 30-35° S, very few in the warm-temperate zone; in *Malesia*: 14 native genera of which 2 are endemic, viz *Hieris* in Penang and *Lamiodendron* in Papuaia. Among the remaining 12 one occurs through the Old World (*Dolichandrone*), 7 are shared with continental SE. Asia (two of which extend also to Africa and Madagascar: *Fernandoa*, *Stereospermum*) and 4 with Australia and Melanesia; the latter occur in Malesia only in the east except *Deplanchea* which ranges westward to Sumatra.

In the family tropical Asia and Africa share a few genera (*Markhamia*, *Fernandoa*, *Stereospermum*, and *Dolichandrone*), but Africa and America share only one, viz *Tecoma*. This latter affinity goes further, though very disjunct via *Campsidium* (Chile) and *Campsis* (N. America and E. Asia) to *Tecomanthe-Pandorea-Neosepicaea* (Moluccas to Three Kings Is. and E. Australia). Otherwise there appear to be only two other transoceanic ties, viz tribe *Crescentieae* which is shared by Africa and the Americas, and the genus *Catalpa* which occurs in E. Asia and the Caribbean area.

As GENTRY (Brittonia 25, 1973, 227-230) has shown, the average number of species per genus (114)

is only 5, which is very small in comparison with many other families, but can only partly be explained by a possibly small generic concept. There are quite a number of monotypic genera (in Malesia 5), but they are well defined in many characters and stand very apart.

This, and the worldwide distribution of the family, and the disjunctions in ranges, definitely point to relict survival and ancient origin, onwards of which period the three tribes have undergone a separate, independent development on the continents, mainly leading to differentiation in Indo-Australia and in the New World, with the greatest abundance in the latter. Unfortunately, the fossil evidence (only Tertiary) is meagre and untrustworthy (SCHUMANN in E. & P. Nat. Pfl. Fam. 4, 3b, 1894, 208), both to macrofossils and to pollen.

Ecology. Within the family there is a fairly wide coverage of habitats and there are quite a few which are confined to arid conditions (*Rhigozum* and *Catophractes* in S. Africa, *Tecomella* in Arabia, *Phyllarthron bernierianum* in Madagascar, *Dolichandrone filiformis*, *D. heterophylla* and the linear-leaved drought form of *Pandorea pandorana* in Australia). A few are rheophytic (*Astianthus* and *Chilopsis* in the Americas). A few are warm-temperate (*Catalpa*) or subtropical-alpine (*Incarvillea* incl. *Amphicome* in the Sino-Himalayas and *Argylia* and *Campsidium* in the Andes). One species is bound to the mangrove (*Dolichandrone spathacea* in Indo-Melanesia).

The majority, however, belongs to the tropical forest, mostly the everwet type, but a fair number in the seasonal type, below c. 2000 m; only *Tecomanthe* ascending to c. 3100 m in New Guinea.

In Malesia most are evergreen, but *Oroxylum indicum* (fig. 5) and *Dolichandrone spathacea* can stand leafless in the dry season for many months. *Fernandoa macroloba* is also deciduous, as are the species of *Stereospermum*.

Habit. The majority of the Malesian genera are small or large trees, the only climbing genera being *Nyctocalos*, *Hieris*, *Tecomanthe*, *Pandorea*, and *Neosepicaea*; in subalpine heathland *Tecomanthe* may be forced to creep on other vegetation.

Most trees are of medium size, but species of *Stereospermum*, *Fernandoa*, *Pajanelia*, and also *Radermachera gigantea* may attain quite good dimensions. *Oroxylum* is a short-lived nomad tree.

Dominance. Almost all species occur scattered in the forest and several are very rare indeed. An exception is *Dolichandrone spathacea*, bound to the swampy, brackish inner mangrove, which according to CORNER (Wayside Trees, 1940, 164) is in the North of the Malay Peninsula, in Perlis, a feature of the country, flanking roads and standing as an upright poplar in the rice-fields. Fig. 16. In Great Natuna I. (NW. off Sarawak) I found *Pajanelia longifolia* locally very common in coastal forest, but this was probably encouraged by devastation. In secondary forests, on earth slides, abandoned fields, and on fresh volcanic ash *Radermachera glandulosa* and *R. gigantea* may be frequent in the pioneer upgrowth in Java (also on Krakatao), but this high frequency is local; KOORDERS mentioned it for G. Telemojo and Pringombo in Central Java. Even *Oroxylum indicum* which is a nomad plant bound to secondary growths is always found in only a few specimens. *Lamiodendron magnificum* was once mentioned by BRASS as forming a community on a gravel bank behind the beach, in Normanby I., but this tree is extremely rare otherwise.

Flower biology. In many species (like in several *Gesneriaceae*, *Verbenaceae*, *Solanaceae*) the calyx develops much earlier than the corolla and is closed in bud. Inside of the calyx with water and slime producing glands and hydathodes in which the corolla develops. These so-called waterbuds are very characteristic, especially in such large-flowered species as *Spathodea campanulata*, the tulip tree, which derives a Dutch and Malay name from this feature (*spuitjesboom*, *panchot*) which is enjoyed by children to play with. It is one of the few biological phenomena which are entirely confined to the tropics, as far as I am aware.

TREUB (Ann. Jard. Bot. Btzg 8, 1889, 38-46, t. 13-15) made an anatomical study of the glands inside the calyx of *Spathodea campanulata* and on his instigation GRESHOFF examined the exudate, dissolved organic and inorganic substances, which appeared similar to those of leaf-hydathodes. KOORDERS (*ibid.* 14, 1897, 354-469, t. 21-27) extended this subject with research on some other genera of *Bignoniaceae* (*Parmentiera*, *Kigelia*, *Crescentia*, *Fernandoa adenophylla*, *Radermachera gigantea*) and some other plants, confirming TREUB's results.

Pollination. Flower-shape, -colour, -position, and -scent are very different in the mostly showy flowers of *Bignoniaceae*, and the syndromes attract different visitors.

Bats are frequently visiting species of certain genera, another phenomenon restricted to tropical plants. According to FAEGRI & VAN DER PIJL (Principles Pollination Ecology, ed. 2, 1971, 154) the attraction syndrome is: nocturnal anthesis, whitish, creamish or drab greenish or dark purple colour, stale or sour, unpleasant smell reminiscent of fermentation at night, large quantity of nectar and pollen in large anthers, large-mouthed and coarse flowers on strong stalks sticking out of the foliage or cauliflorous to flagelliflorous flowers, thus coming into easy reach for landing. This is found in Malesia in several cultivated genera (*Kigelia*, *Crescentia*, *Parmentiera*, *Markhamia*, etc.) but occurs also in the native *Fernandoa adenophylla*, *Pajanelia*, and *Oroxylum*. Fig. 7. Notwithstanding the many papers and records of observation — corollas show claw marks after these visits — it is not proved to my satisfaction that visits of bats are compulsory for pollination *q. q.* fertilisation, experimenting being in this field deplorably meagre. My doubt is strengthened by observations by HARRIS & BAKER in Ghana where *Kigelia* is native (J. West Afr. Sc. Assoc. 4, 1958, 28) and can set fruit in absence of bats; they observed also frequent visits by sphingids but they doubt effective pollination by these.

Birds, humming birds and sun-birds, frequently visit certain species, the attraction syndrome being: tubed, vividly coloured (orange, scarlet), diurnal, mostly odorless, nectar-producing tubular flowers. Here also many observations are made, e.g. in *Tecoma* (*Tecomaria*). To this class belong in Malesia some species of *Radermachera* (*R. ramiflora*), *Neosepicaea*, *Tecomanthe*, and it can be expected for *Deplanchea*. Also the cultivated *Spathodea campanulata* is frequented by birds (*cf.* BEUMÉE, Trop. Natuur 14, 1925, 28–30), notably kutilans and ?djalaks, at Bogor; they severely damage the corolla. Here again the question whether bird-visits are compulsory for pollination *q. q.* fertilisation is inadequately supported by experiments. Caution is necessary to conclude to the necessity of cross-pollination, as e.g. HUNTER (Rec. Auckl. Inst. Mus. 6, 1967, 169–170, t. 24) recorded that in *Tecomanthe speciosa*, of which cuttings of a single plant led to its cultivation, fertilisation — that is selfing — could be effected by hand-pollination, but later also naturally by bees, although far from its native habitat.

Moths. A few species have the moth-attraction syndrome for flower visitors, which implies: nocturnal, very fragrant flowers with abundant honey, in mostly pale or white, long-tubed or salver-shaped corollas. Fig. 1, 8, 15. This is found in species of *Nyctocalos*, *Dolichandrone*, *Hieris*, *Millingtonia*, and some species of *Radermachera* (e.g. the Chinese *R. sinica*, *R. pentandra*, and *R. peninsularis*). Probably long-tongued sphingids (hawk-moths) visit these flowers.

Bees and butterflies. Possibly bees visit flowers of species not belonging to the three categories mentioned above.

The ecological role of the many sorts of extra-floral nectaries is unexplained.

It is a fact that in general fruit setting is scarce in *Bignoniaceae*; in several the fruit was only occasionally found long after the plant had been described in flower. In Malesia the fruit is still unknown of *Hieris* and *Lamiodendron*. Even after abundant flowering fruit production is often very low with 1 or 2 fruits in each inflorescence, except in *Radermachera glandulosa* and *Tecomanthe stans*. With all these flower visit devices one would expect otherwise.

Dispersal. *Bignoniaceae* occur throughout the tropics and several are still found in the subtropics of the whole world. One might ascribe this to their having winged seed (except *Crescentieae* and a few other exceptions), but against expectations they are almost absent from oceanic islands. *Bignoniaceae* occur all along the coasts of the West Pacific, notably in New Guinea and in Australia species of *Tecomanthe* and *Pandorea* are not rare, but the only occurrence in the West Pacific islands is a common Australian *Pandorea* in New Caledonia and Lord Howe I., and a peculiar *Tecomanthe* in a single locality of the Three Kings Is., the northernmost territory of New Zealand.

Obviously wind dispersal has not been as effective as one would expect.

Dispersal by seawater is common in *Dolichandrone spathacea*, a back-mangrove species, ranging from the western Deccan Peninsula to North Luzon, south to Timor and southeastwards to New Caledonia; the range is almost continuous without gaps. Fig. 14. It is most peculiar, however, that so far it has never been found in the mangroves of northern Australia. Its seeds have thickish corky wings instead of flimsy wings as usual in most members of the family (except the fleshy indehiscent fruits of the *Crescentieae* and a few other exceptions as e.g. *Pauldopia*) and are most excellently adapted to be dispersed by seawater.

Seedlings. These are very uniform in all tribes of the family; in the embryo the foliaceous cotyledons are flat in one plane, mostly emarginate at both ends, hypocotyle and rootlet are small. Germination is epigeal by stretching of the hypocotyle. The first leaves are mostly simple, as in most compound-leaved families; they are often dentate. In a very few genera with thick seeds there may develop — possibly by intrusion of the testa — a false septum in the seed, in Malesia notably in *Stereospermum* and here also the cotyledons are folded. The only exception is mentioned by LUBBOCK (Contr. Knowl. Seedlings 2, 1892, 334, fig. 569) for '*Bignonia insignis*' with fleshy connate cotyledons and hypogeal germination; the name is evasive and at Kew the identity could not be traced; presumably the record rests on an error.

Literature: E. BUREAU, Monogr. Bign. (1864); J. LUBBOCK, Contr. Knowl. Seedlings 2 (1892) 332–345, fig. 569–575; R. S. TROUP, Silv. Indian Trees 2 (1921) 684–693; J. A. DUKE, Ann. Mo. Bot. Gard. 52 (1965) 349, pl. 20; G. DE LA MENSBRUGE, La germination et les plantules essences arbres Côte d'Ivoire; Techn. For. Trop. Nogent-sur-Marne, Paris (1966) 332–333; D. BURGER, Seedlings (1972) 52–54; C. S. SCHOPMEIJER, Seeds Woody Pl. U.S., Agric. Handb. 450 (1974) 260, 281, 321.

Juvenile plants of *Pandorea pandorana* show leaves very different from the mature foliage, in having many jugae and being coarsely dentate. *Tecoma filicifolia* NICHOLS. was based on such material. This led also to a serious misinterpretation of *Tecoma leptophylla* BL., from New Guinea, of which the juvenile leaves (fig. 37b) are *Pandorea pandorana* but the flowers belong to *Neosepicaea*.

Taxonomy. Since the basic work on the systematy by E. BUREAU (Monographie, 1864), the treatment of the family in Flora Brasiliensis by BUREAU & SCHUMANN (1896–97), and the treatment of SCHUMANN in the Pflanzenfamilien (1895) the traditional subdivision of the family in 5 tribes has proved satisfactory. *Crescentieae* with 1-celled berries occur in Africa and the Americas, two other monogeneric tribes are South American, while the bulk of the family belongs to *Bignoniaceae* and *Tecomeae*, of which the latter are about balanced as to number of genera in the Old and New World, but *Bignoniaceae* are predominantly American. These two tribes are largely distinguished on the dehiscence of the fruit, loculicid in *Bignoniaceae* and septicid in *Tecomeae*.

In passing it may be remarked that GENTRY (Pl. Syst. Evol. p. 126, 255) recently advocated that *Crescentieae* of the neo-tropics and of Africa-Madagascar are of separate descent and would represent two parallel evolutionary lineages; this suggestion is more based on geographic argument and evolutionary hypotheses than on morphological arguments.

The delimitation against other families of *Sympetalae* is well-defined, but there are a few genera, notably *Wightia* and *Paulownia*, which are sometimes referred to *Bignoniaceae*, though FENZL (Denkschr. K. Bay. Bot. Ges. Regensburg 3, 1841, 227–230), BUREAU, SCHUMANN, VON WETTSTEIN, and other specialists referred them to *Scrophulariaceae*. A survey of opinions I gave in my paper on *Wightia* (Bull. Bot. Gard. Btzg III, 18, 1949, 214–216), in which I excluded it from *Bignoniaceae*. Even recently *Paulownia* is sometimes casually treated as Bignoniaceous (e.g. SCHOPMEIJER, Agric. Handb. U.S.A. 450, 1974, 527), although the embryo is embedded in endosperm; furthermore the stigma is different from that in *Bignoniaceae*, the anthers have no prolonged connective, there is no rudimentary stamen and the seeds are provided with several wings and seem to be laterally attached, not transverse as in *Bignoniaceae*. For *Wightia* I tabulated (*l.c.*) the relation to both families. Its seeds have no endosperm, but the absence of a staminode, the structure of the stigma, the central placenta and the absence of a produced connective on the anthers point distinctly to *Scrophulariaceae*. The seed is quite differently attached as compared with *Bignoniaceae*, viz laterally and the wing surrounds the entire seed. Its wood has two kinds of medullary rays, narrow and broad ones, a character which, at least in Malesian *Bignoniaceae*, is absent.

Though the capsule in *Wightia* is septicid and in *Paulownia* loculicid, both genera have the same kind of axile placentation, in which the thickened placenta becomes detached from the valves as a subquadrangular seed-cake, showing their close affinity, completely differing from the situation in *Bignoniaceae*.

According to SURYAKANTA (J. Palyn. 9, 1973, 73) the pollen of both genera differs from that in *Bignoniaceae* and resembles that of *Scrophulariaceae*.

NAKAI (J. Jap. Bot. 24, 1949, 13) accommodated *Paulownia* in *Paulowniaceae*, probably in-

duced mostly by its arboreous habit and fruit; they certainly merit to be placed in a separate tribe or subtribe of *Scrophulariaceae*. We regard nowadays the arboreous habit as primitive in herbaceous families and we might conclude that they are ancient relicts from a period when *Bignoniaceae* and *Scrophulariaceae* had a common matrix.

Also in South America there are two woody genera of the *Scrophulariaceae* which were at times referred to *Bignoniaceae*, viz *Schlegelia* (syn. *Dermatocalyx*) and *Gibsoniothamnus*, according to GENTRY (Fieldiana, Bot. 34, 1971, 55; Ann. Mo. Bot. Gard. 61, 1974, 533–537); see also LEINFELLNER (Oest. Bot. Z. 121, 1973, 13–22). They are (hemi-?) epiphytic shrubs or lianas, a similar habit as in *Wightia*.

Genetics. *Chromosomes*. DARLINGTON & WYLIE (Chrom. Atlas, 1955) and MOORE (ed.) (Regn. Veg. 90, 1973) gave for 26 genera $x = 20$ ($2n = 40$) and they belong to *Tecomeae*, *Bignoniaceae* and *Crescentieae*, both from the palaeo- or neotropics. There is one higher number $x = 22$ (*Amphilophium*, South America, *Niedzwedzkia* = *Incarvillea*) and several lower ones: *Pandorea*, and some doubtful countings in *Tecoma* $x = 19$, *Tecomanthe dendrophila* $2n = 36$ (Christine BRIGHTON in litt.), *Jacaranda* $x = 18$, *Tecoma capensis* $x = 17$, *Oroxylum*, *Millingtonia*, *Argylia* (from South America) $x = 15$, *Spathodea* $x = 13$, and *Incarvillea* $x = 11$. In supplement indices *Campsis* is also given as 16 and *Oroxylum* as 14.

I have scanned the numbers of *Scrophulariaceae*, *Gesneriaceae* and *Verbenaceae*, but can find no reliable ties, *Bignoniaceae* being obviously more homogeneous than those.

The number given for *Paulownia*, $2n = 40$, $x = 10$, might as well fit *Bignoniaceae* as *Scrophulariaceae*.

Hybridisation. Not many species hybrids are known to me, but those known are interesting, as there are at least two between species of East Asia and SE. North America which are now very disjunct after the Pleistocene Ice Age; it is not impossible that they formed part of more continuous populations in the warmer Pliocene via Beringia. This idea is supported by the fact that in both cases the hybrids are fertile.

E. C. SMITH (J. Arn. Arb. 22, 1941, 219) reported on *Catalpa ovata* DON \times *C. bignonioides* WALT. (= \times *C. syringifolia* SIMS). Haploid all have 20 chromosomes (SAX, J. Arn. Arb. 14, 1933, 274).

Then there is \times *Campsis tagliabuana* (VIVIANI) REHDER, a hybrid between the Chinese *C. grandiflora* (THUNB.) K. SCH. (*C. chinensis* (LAMK.) VOSS.) and *C. radicans* (L.) SEEM. which produces fertile progeny (cf. STEARN, Bot. Mag. 169, 1953, t. 198).

The third one is also bi-continental, *Tecoma smithii* W. WATSON (Gard. Chron. 14, 1893, 649, fig. 104; E. SMITH, *ibid.* 16, 1894, 64; cf. also Gartenflora 44, 1895, 51, fig. 14). This is a reputed hybrid, which E. SMITH made at Adelaide, in 1882, between *T. velutina* (a hairy variety of *T. stans*) and *T. capensis*. It was propagated by cuttings, but it produced seed and its offspring of seedlings diverged in size and flower colour. Curiously SPRAGUE, in a succinct note (Fl. Cap. 4, 2, 1904, 448) reduced it to *T. alata* DC., without referring to its hybrid nature.

Anatomy. *Wood*. Of the Malesian *Bignoniaceae* only a small proportion of tree species is known wood-anatomically; the climbing and scandent species are fully unexplored in this respect. Anomalous structure has, however, been described for several genera outside Malesia. As far as known, the Malesian tree genera are wood-anatomically rather homogeneous: with simple, rarely also reticulate, perforations to the vessels, homogeneous rays, mainly paratracheal, aliform or confluent parenchyma, and fibres with simple to minutely bordered pits. Except for its unusually narrow rays, *Dolichandrone spathacea* from the mangrove swamps does not differ appreciably from the inland genera in its wood structure.

Leaves. Very poorly known for the Malesian representatives. Diversity of stomatal type and indumentum (non-glandular and glandular hairs in a variety of forms) certainly deserves detailed comprehensive studies, which will probably yield important additional taxonomic characters.

References: *General surveys*: SOLEREDER, Syst. Anat. Dicot. Stuttgart (1899, 1908); METCALFE & CHALK, Anat. Dicot. Oxford (1950). — *Wood*: JANSSONIUS, Mikrographie des Holzes 4 (1926) 721–753 (*Dolichandrone*, *Oroxylum*, *Stereospermum*); PANSHIN, Philip. J. Sc. 48 (1932) 143–205 (*Dolichandrone*); DESCH, Mal. For. Rec. 15 (1941) 50 (*Deplanchea*, *Dolichandrone*, *Pajanelia*, *Stereospermum*); JANSSONIUS, Blumea 6 (1950) 450–452 (affinities); SEBASTINE, J. Ind. Bot. Soc. 34 (1955) 299–306 (*Pajanelia*); JUTTE, Nova Guinea 10 (1959) 242 (*Deplanchea*). —

Leaves: SIEBERT, Ann. Mo. Bot. Gard. 35 (1948) 123–136 (glands); PALIWAL, Flora 159 (1970) 124–132 (stomata). — P. BAAS.

Pollen morphology. *Bignoniaceae* have a long history of pollenmorphological study, starting with the pioneer studies of H. MOHL (1835). The first author to present a detailed pollen-morphological survey of the family, drawing attention to the taxonomical significance of the pollen characters, was URBAN (1916). He concluded that (1) any attempt to base the main subdivision of the family on pollen characters would group together taxonomically unrelated genera, (2) for generic delimitation pollen had limited value. Later studies by several authors have confirmed this (*cf.* BUURMAN, in the press).

Inaperturate, tricolpate, stephanocolpate and pericolpate apertural types occur in the family. In a few genera tetrads are found.

Size ranges between 25 μm in *Astianthus antisiphilitica* and 100 μm in *Nyctocalos cuspidata*, shape varies between suboblate and subprolate.

Remarkable is the amount of variation which may occur within genera or even intraspecifically. In *Stereospermum* inaperturate, tricolpate and perisyncolpate pollen is found, while in *Anemopaegma longepetiolatum* inaperturate, stephanocolpate, pericolpate grains as well as tetrads occur. In such cases sculpture affords more constant characters.

The tricolpate type is dominant in the family and is found in all four tribes. It rarely shows well developed equatorial endoapertures. Instead, characteristically ruptured aperture membranes are present, especially in *Tecomeae*. Operculate colpi occur in *Argylia*. A subdivision of the tricolpate type is possible on sculpture, which mostly varies between perforate and reticulate.

In some genera very complex pollen grains are present, such as those of *Nyctocalos* (fig. 2).

The tricolpate pollen grains in *Bignoniaceae* resemble those in *Scrophulariaceae* and *Myoporaceae*. The similarities with *Pedaliaceae*, stressed by ERDTMAN (1952) refer to a rather specialized pollen type and may not reflect close affinity.

References: MOHL, Ann. Sc. Nat. II, 3 (1835) 304–346; URBAN, Ber. Deut. Bot. Ges. 34 (1916) 728–758; ERDTMAN, Pollen morphology and plant taxonomy. Angiosperms. Almqvist & Wiksell, Stockholm (1952) 73–74; BUURMAN, Contribution to the pollenmorphology of the *Bignoniaceae*, with special reference to the tricolpate type (in the press). — J. MULLER.

Chemotaxonomy. *Bignoniaceae* share a number of biochemical tendencies with *Verbenaceae*, *Labiatae*, *Scrophulariaceae* and with several other families of WETTSTEIN's *Tubiflorae*. Most of their outstanding chemical characters were already mentioned and discussed in my 'Chemotaxonomie der Pflanzen' vol. 3 (1964) 268–281, 645–646, to which the reader is referred. Much phytochemical information, however, became available only in more recent time. Recent results confirm the trends already apparent in 1963; they are summarized in the following pages. Chemical characters of *Bignoniaceae* may ultimately prove to be very useful in tracing inter- and intrafamilial relationships.

(1) Most members seem to produce and accumulate iridoid glucosides (formerly often called pseudoindicans). Since a long time *Bignoniaceae* are known to contain labile glycosidic bitter principles. Such a compound was isolated in 1888 from the bark and fruits of *Catalpa bignonioides* WALTER and called catalpin (name changed later to catalposide). The structure of catalposide was definitely established in 1962; it is an aucubin-type (C_9 -aglucone) ester glucoside and one of the first pseudoindicans for which clearcut structural and biogenetic relationships with iridodial and nepentalactone were demonstrated (hence the name iridoid glucosides for a presently very large group of constituents of dicotyledonous plants). Catalposide (tastes bitter) is an ester of *p*-hydroxybenzoic acid with catalpol (= 7,8-epoxy-aucubin). Catalpol and catalposide occur in all species of *Catalpa* (leaves, stems, fruits) and catalpol (= catalpinoside) was also isolated from barks of *Paulownia tomentosa* STEUD. and *P. fargesii* FRANCH. where it occurs together with syringin (V. PLOUVIER, C. R. Ac. Sc. Paris 272D, 1971, 1443). Probably catalpol and catalposide occur in many more members of the family. In most recent times some related glucosides were isolated from *Bignoniaceae*. Vanilloyl-catalpol (= amphicoside) is a constituent of *Amphicome emodi* LINDL. and veratroyl-catalpol occurs in *Tecomella undulata* SEEM. 5-Hydroxycatalpol (= macfadyenoside) was isolated from *Macfadyena cynanchoides* MORONG. All iridoid glucosides mentioned hitherto have structures based on the aucubin-derivative catalpol. The first non-aucubin-type glucoside described from *Bignoniaceae* is tecomoside with a C_{10} -aglucone; it was

isolated from *Tecoma capensis* LINDL. (A. BIANCO *et al.* Gazz. Chim. Ital. 105, 1975, 195). It is to be expected that much more iridoid glucosides will be detected in the family in future.

(2) Some *Bignoniaceae* produce alkaloids. So far only pyridine-type and piperidine-type alkaloids with an iridoid C₁₀- or rarely C₉-skeleton were identified definitely in species belonging to this family. This fact strengthens the belief that the tendency to produce iridoid compounds is a very important character of *Bignoniaceae*. Thusfar simple iridoid alkaloids were described for species of *Campsis* (boschniakine), *Incarvillea* (plantagonine, indicain), *Tecoma* (tecomanine, tecostidine, tecostanine, boschniakine, 4-noractinidine and several derivatives of skytanthine). The basic constituents of *Amphicome* (now reduced to *Incarvillea*), *Newbouldia* and other genera may belong to the same group of alkaloids.

A recent review of the chemistry, distribution and systematic meaning of all presently known main groups of iridoid plant constituents was published by S. ROSENDAL JENSEN *et al.* (Bot. Notis. 128, 1975, 148–180).

(3) Many *Bignoniaceae* synthesize naphthaquinones and corresponding anthraquinones by prenylation of *o*-succinylbenzoic acid. This pathway to quinonoid naphthalene- and anthracene-type secondary metabolites is presently known from taxa belonging to *Rubiaceae*, *Verbenaceae*, *Scrophulariaceae*, *Bignoniaceae* and possibly *Acanthaceae* and *Gesneriaceae*. In roots, woods and barks of *Bignoniaceae* lapachol, lapachonone, α - and β -lapachone and dehydro- α -lapachone occur frequently. These monomeric naphthaquinonoid compounds are often accompanied and sometimes replaced by more complex dimeric constituents like tectol, guayacanine and guayine and by corresponding anthraquinones such as tectoquinone and 2-methyl-3-hydroxyanthraquinone. Woods which contain appreciable amounts of these quinonoid compounds are more or less resistant to marine borers, white ants and *Fungi*. At the same time such woods may be the causes of skin irritations and of allergic skin diseases in man. Lapachol- and tectoquinone-type substances are presently known from species of the genera *Catalpa*, *Heterophragma*, *Kigelia*, *Paratecoma*, *Phyllarthron*, *Stereospermum*, *Tabebuia*, *Tecoma*, *Tecomella*, and *Zeyhera*. R. H. THOMSON has reviewed the chemistry and distribution of quinones and related compounds in his book 'Naturally occurring quinones' (2nd ed. 1971). The phthalide catalpalactone from the wood of *Catalpa bignonioides* WALTER and *C. ovata* G. DON arises from the same pathway as lapachol and its congeners (H. INOUE *et al.* Chem. Pharm. Bull. Tokyo 23, 1975, 384, 392, 2523). On the other hand it should be stressed that the red-coloured naphthaquinones of *Boraginaceae* (e.g. alkannin) which are structurally very similar to lapachol are produced along a totally different biosynthetic pathway (cf. E. LEISTNER, Chinoide Farbstoffe, Ber. Deut. Bot. Ges. 88, 1975, 163–178).

(4) The "tannins" mentioned for many *Bignoniaceae* in the older phytochemical literature (e.g. DEKKER, 1913) seem to be glycosides and esters of *o*-diphenolic compounds. Orobanchin (= verbascoside)-type ester glycosides were definitely demonstrated to occur in species of *Campsis*, *Catalpa*, *Eccremocarpus* and *Pandorea*. A review of this type of polyphenolic plant constituents which simulate true tannins in some respects is to be found in my 'Chemotaxonomie der Pflanzen' vol. 5 (1969) 250–252. Orobanchin yields a molecule of caffeic acid, 3,4-dihydroxyphenylethanol, glucose and rhamnose each. Just as in most other families of *Sympetalae* true tannins are replaced in *Bignoniaceae* by more or less complex esters and glycosides of *o*-diphenolic cinnamic acid derivatives. Moreover, simple esters of caffeic acid and biosynthetically related derivatives of cinnamic and benzoic acids are present in large amounts in many *Bignoniaceae*. The recent investigations of V. B. PANDEY and B. DASGUPTA with the bark of *Tecomella undulata* SEEM. (veratroylglucose = tecomin: Experientia 26, 1970, 1187) and of M. SUGUMARAN *et al.* with leaves of *Tecoma stans* H.B.K. (16 aromatic acids: Ind. J. Exper. Biol. 13, 1975, 93) exemplify this trend. *p*-Hydroxybenzoic acid is present as an ester in all species producing catalposide; probably this phenolic acid is rather ubiquitous in the family. The presence of appreciable amounts of hydroquinone (in living cells as the glucoside arbutin?) in leaves of *Jacaranda mimosaeifolia* D. DON (S. SANKARA SUBRAMANIAN *et al.* Phytochemistry 12, 1973, 220) might be connected with a strong tendency to produce and accumulate *p*-hydroxybenzoic acid; if this is actually the case hydroquinone (and arbutin?) may be detected in much more *Bignoniaceae* in future. Jacaranone, a quinonoid compound which exhibits antitumor and cytotoxic activity was recently isolated from leaves and twigs of *Jacaranda caucana* PITTIER (M. OGURA *et al.* Lloydia

39, 1976, 255); it seems to be derived from tyrosine and is chemically very similar to the *Cornus* quinol glucoside (= cornoside) which is also present in leaves of *Digitalis purpurea* (Bot. Notis. 128, 1975, 174).

(5) According to J. B. HARBORNE (Phytochemistry 6, 1967, 1643) leaf flavonoid patterns of *Bignoniaceae* are close to those of *Acanthaceae*, *Gesneriaceae*, *Labiatae* and *Scrophulariaceae*. Features which support such a statement are the replacement of flavonols by flavones in many species, the relatively frequent occurrence of flavones with an unsubstituted B-ring (e.g. chryson, baicalein), of 6-hydroxylation of chrysin (baicalein), apigenin (scutellarein) and luteolin (6-hydroxyluteolin) and of O-methylation of flavones. The latter trend is illustrated by *Zeyhera tuberculosa* BUR. ex VERLOT which contains 5,6,7-trimethoxyflavone and 5,6,7,8-tetramethoxyflavone in leaves (J. P. KUTNEY & H. W. HANSEN, Phytochemistry 10, 1971, 3298). The bitter principle of the fruits of *Sparattosperma vernicosum* BUR. & K. SCH. was shown by J. P. KUTNEY et al. (Phytochemistry 9, 1970, 1877) to be the 7-neohesperidoside of pinocembrin (= 2,3-dihydrochryson).

(6) Free triterpenic acids occur in appreciable amounts in leaf waxes of many families of *Tubiflorae* (especially *Verbenaceae*, *Labiatae* and *Plantaginaceae*) and related orders. It is of interest in this respect that ursolic acid was isolated in recent time from leaves of *Bignonia diversifolia* H.B.K., *Campsis radicans* SEEM., *Catalpa bignonioides* WALTER, *Heterophragma quadriloculare* K. SCH., *Jacaranda mimosaeifolia* D. DON (not definitely identified) and *Paulownia tomentosa* STEUD. The bark of *Jacaranda mimosaeifolia* yielded lupenon.

(7) Many members of *Verbenaceae*, *Labiatae*, *Scrophulariaceae* and *Plantaginaceae* replaced starch by stachyose-type oligosaccharides as storage carbohydrates. The same trend seems to exist in *Bignoniaceae*. Large amounts of stachyose occur in species of *Catalpa* (roots, wood, bark), *Newbouldia laevis* SEEM. (roots) and *Paulownia tomentosa* (stem).

(8) Most representatives of *Tubiflorae* produce starch-free seeds which are rich in proteins and oils. The seed oils are often characterized by a high degree of unsaturation. In this respect *Bignoniaceae* conform to the rule. Their seeds generally contain 20–35% of oil. In some taxa oleic and (or) linolic and (or) linolenic acid are the only major fatty acids of the seed oils (e.g. species of *Crescentia*, *Niedzwedzia* = *Incarvillea*, *Paulownia* and *Stereospermum*). In other taxa the 'normal' fatty acids are accompanied or replaced by large amounts of unusual fatty acids such as conjugated trienoic acids (species of *Catalpa*, *Chilopsis*, *Jacaranda*), C_{26} -keto-acids (*Cuspidaria pterocarpa* DC.), octadeca-*trans*-3,*cis*-9,*cis*-12,*cis*-15-tetraenoic acid (*Tecoma stans* H.B.K.) or hexadec-9-enoic and octadec-11-enoic acid (*Doxantha unguis-cati* MIERS). M. J. CHISHOLM and C. Y. HOPKINS discussed the chemistry of seed oils of 11 species representing 4 tribes (Canad. J. Chem. 43, 1965, 2566).

The preceding phytochemical picture places *Bignoniaceae* phytochemically very close to a number of families of *Tubiflorae*, especially *Verbenaceae*, *Labiatae* and *Scrophulariaceae*. Still other constituents are known from *Bignoniaceae*. Lack of acquaintance with their structures and (or) with their distribution, however, does not yet allow a systematic evaluation. Saponins, which seem to be rather widespread in the family but were never investigated in detail, belong to these chemical characters. The same holds for a number of phenolic compounds isolated in recent time, such as the lignans sesamin and paulownin from *Paulownia tomentosa* STEUD. and *Phyllarthron comorense* DC., the dilignol (a lignan-type compound) zeyherol from *Zeyhera digitalis* HOEHNE and the dihydroisocoumarins 6-methoxymellein, kigelin and 6-demethylkigelin from *Kigelia pinnata* DC.

Concluding it may be stated that the intimate relationships between *Bignoniaceae* and *Scrophulariaceae* which are indicated by genera like *Catalpa* and *Paulownia* (often placed in *Scrophulariaceae*) are confirmed by phytochemistry. At the same time phytochemistry stresses a very close coherence of a core of families of *Tubiflorae*; this core comprises *Scrophulariales sensu* CRONQUIST (1968) and *Lamiales sensu* TAKHTAJAN (1969). — R. HEGNAUER.

Uses. There are no outstanding qualities marking *Bignoniaceae* as useful plants, otherwise than ornamentals and these concern mostly the introduced species for which I refer to the special key and account at the end. There are magnificent native species notably of *Tecomanthe* but they have as yet not become in general use.

Good roadside trees are *Millingtonia hortensis* and *Spathodea campanulata*. A highly esteemed

vegetable (*lalab*) with the Sundanese is *Oroxylum indicum* (flowers, buds, and very young pods).

For re-afforestation and holding terraces on slopes the pioneer qualities of species of *Radermachera* and *Deplanchea* might be useful.

The timber is in general not valuable and in nature not available in sufficient quantity. The soft wood of *Millingtonia hortensis* was advertized as useful for tea-boxes. The only species yielding sizeable timber of good quality are: *Fernandoa macroloba*, *Pajanelia longifolia*, *Radermachera gigantea*, and the three species of *Stereospermum*, which all may be valuable for silviculture.

Terminology. The shape of the corolla has been defined as tubular (fig. 4b, 10e) in which case there can be a distinction in a basal tube (on apex of which inside the stamens are inserted) as in fig. 4b; funnel-shaped (fig. 23d, 26c), hypocateriform or salver-shaped (fig. 1a, 8c, 15) or infundibuliform (fig. 32a).

Notes. Since my thesis (Rec. Trav. Bot. Néerl. 24, 1927, 787–1049), here always cited as 'Thesis (1927)', and subsequent revision in Bull. Jard. Bot. Btzig III, 10 (1928), I have remained always much interested in this family and have published some revisions and many notes precursory to the present treatment. I have to thank the late Mr. N. Y. SANDWITH (Kew) for namings of cultivated species, and Dr. A. L. GENTRY (St. Louis) for recent information on them, Dr. H. HEINE (Paris) for assistance in various matters, Mr. Michael GALORE (Lae) and Prof. E. J. H. CORNER (Cambridge) for photographs, Miss Christine BRIGHTON (Jodrell Lab., Kew) for the first chromosome count in *Tecomanthe*, while I gratefully acknowledge precursory work performed by Mr. J. C. DEN HARTOG on *Tecomanthe* and *Pandorea* in 1969/70 at the Rijksherbarium where he worked as a graduate student.

KEY TO THE GENERA¹

1. Erect trees or shrubs.
 2. Leaves simple, mostly in whorls 6. *Deplanchea*
 2. Leaves compound, almost always decussate.
 3. Leaves 1-pinnate.
 4. Leaf rachis with a sharp, keel-like ridge above. Leaflets 8–12 pairs. Capsules winged 12. *Pajanelia*
 4. Leaf rachis not keeled above. Leaflets less than 6 pairs. Capsules not winged.
 5. Corolla salver-shaped, white, nocturnal, the tube 12–18 cm long, narrow-cylindric. Calyx spathaceous to the base, 3–6 cm. Leaves nigrescent, with domatia. A flat pseudoseptum developed parallel to the valves. Seeds rectangular, with corky wings as thick as the seed 7. *Dolichandrone*
 5. Corolla much shorter. No pseudoseptum. Seeds with hyaline wings. Leaves not nigrescent.
 6. Mature leaflets serrate, crenate, or pinnatifid 5. *Tecoma*
 6. Mature leaflets entire.
 7. Calyx regularly 5-lobed, rather thin, reticulately veined, short-hairy, 2–3 cm 11. *Lamiodendron*¹
 7. Calyx lobes unequal, often less than 5; calyx not thin and reticulate-veined.
 8. Capsule rather flattened, with a flat septum, if terete with 10 ribs 10. *Fernandoa*
 8. Capsule terete, with a terete septum, never with many ribs, sometimes one ridge on each valve. No domatia in *Mal. spp.*
 9. Seeds thick, in one row in each cell, each fitting in deep notch in the septum. Valves rather hard. Ovules in 2 rows in each cell 8. *Stereospermum*
 9. Seeds thick, in many rows, the septum without notches. Valves thin. Ovules in many rows in each cell 9. *Radermachera*
 3. Leaves 2–3(–4)-pinnate.
 10. Flowers fleshy, very coarse: calyx 2–4 cm, corolla wide, dirty violet or reddish purple to liver brown, 7–10 cm. Capsule flat, sword-shaped, 60–120 cm. 3. *Oroxylum*
 10. Flowers not fleshy, much smaller or thinner, white or pink. Capsule smaller and of different shape.
 11. Leaflets with domatia. Corolla white, salver-shaped, the tube 6–8 cm long, cylindric, 2 mm wide. Capsule compressed parallel to the septum, the latter parallel to the valves; dehiscence septicidal. 4. *Millingtonia*
 11. Leaflets without domatia. Corolla tube otherwise, wider. Capsule cylindric, with a terete corky septum attached perpendicular to the valves; dehiscence loculicidal. 9. *Radermachera*
 1. Lianas.
 12. Corolla salver-shaped, with a narrow cylindric tube, 5–19 cm long. Capsule flat, large, with a median lengthwise ridge. Septum parallel to the valves, dehiscence loculicid 1. *Nyctocalos*
 12. Corolla not salver-shaped, tubular, infundibuliform or funnel-shaped.

(1) Of *Lamiodendron* and *Hieris* the fruit is still unknown.

The key given here is only to native and thoroughly naturalized species (only *Tecoma stans*). A tentative key to the cultivated species is added in an appendix on page 180.

13. Corolla tube \pm geniculate above the basal tube, upper tube slightly curved and flattened with a prominent fold. Calyx c. $\frac{1}{2}$ cm, below the very short lobes with a short spur-like tooth. Ovules 6-8 per cell, in \pm two rows. Leaflets 5, those of the lower pair sessile 2. *Hieris*¹
13. Corolla tube not geniculate, without a fold. Ovules ∞ per cell in several rows. Capsule loculicid, with boat-shaped valves. 13. *Neosepicaea*
14. Leaves digitate, with 3(-5) leaflets. Corolla lobes valvate 13. *Neosepicaea*
14. Leaves pinnate, with 1 or more pairs of leaflets. Corolla lobes imbricate. 14. *Tecomanthe*
15. Flowers in racemes, axillary, mostly on the old wood, rarely terminal (in a high-mountain *sp.*), the rachis at the base usually with several crowded pairs of minute sterile bracts. Calyx large, 15-40 mm, distinctly lobed. Corolla large, mostly red, 5-12 cm long incl. the lobes, not bearded in the mouth and upper part of the tube, but stipitate hairy at the insertion of the stamens (rim of the basal tube). Corolla lobes usually deltoid, very narrowly overlapping. Anther-cells 4-5(-10) mm long. 14. *Tecomanthe*
15. Flowers in thyrses, only occasionally depauperate into racemes, usually terminal, sometimes axillary or on old wood. No sterile bracts at base of peduncle. Calyx small, mostly stunted or very shortly lobed, 2-7 mm. Corolla incl. lobes up to c. $3\frac{1}{2}$ cm (in a single Australian species with large lobes c. 5 cm), usually white or yellowish with red dots or streaks inside lobes and mouth, often bearded in the mouth and upper part of the tube, sometimes with a hair-ring at the insertion of the anthers. Corolla lobes widely overlapping, often roundish. Anther-cells $1\frac{1}{2}$ -2 mm long 15. *Pandorea*

Tribe 1. Bignonieae

B. & H. Gen. Pl. 2 (1876) 1027; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 209; BUREAU, Fl. Bras. 8, 2 (1896) 16. — *Eubignonieae* ENDL. Gen. Pl. (1839) 712. — *Subtribe Eubignonieae* DC. Rév. Bign., Bibl. Univ. Genève (1838) 122; FENZL, Denkschr. K. Bay. Bot. Ges. Regensburg 3 (1841) 262; DC. Prod. 9 (1845) 143.

Capsule septicid, the septum parallel to the valves. Frequently lianas, with tendrils, mostly in the neotropics.

Note. BOJER (Hort. Maur. 218) and DC. (*l.c.*) included the two present tribes in *tribe Bignonieae*.

1. NYCTOCALOS

T. & B. in Miq. J. Bot. Néerl. 1 (1862) 366; BUREAU, Mon. (1864) 52; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 201; *ibid.* 3 (1867) 249; SEEM. J. Bot. 8 (1870) 147; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 219 ('*Nycticalos*'); STEEN. Thesis (1927) 805; Bull. Jard. Bot. Btzg III, 10 (1928) 178; Acta Bot. Neerl. 2 (1953) 306; SANTISUK, Kew Bull. 28 (1973) 182. — **Fig. 1-2.**

Lianas, without tendrils. *Leaves* pinnately 3-foliolate (in one *extra-Mal. sp.* 1-pinnate with 5 leaflets). Leaflets herbaceous to chartaceous, entire, \pm elliptic, acuminate, with a few scattered crateriform glands along and spaced from the midrib underneath, above very fine punctate-pitted glandular. *Inflorescence* a short lateral or terminal 8-12-flowered raceme. Pedicels bracteolate. *Flowers* nocturnal, erect, fragrant; lobes widely imbricate. *Calyx* cup-shaped, truncate, with 5 horn-like teeth, the latter with glands on both sides. *Corolla* almost actinomorphic, salver-shaped, the long narrow basal tube dilated in the upper part, with 5 rounded unequal or subequal lobes. *Stamens* inserted in the throat 4 with or without a rudiment or 5, equal or 2 anterior ones sometimes longer, not exerted; anther-cells divergent, versatile; filaments glabrous and no hairs near their insertion. Disk annular, fleshy. *Ovary* with ∞ rows of ∞ ovules along the margins of the dissepiment; style long, filiform. *Capsule* large, flat, stalked and acuminate but with

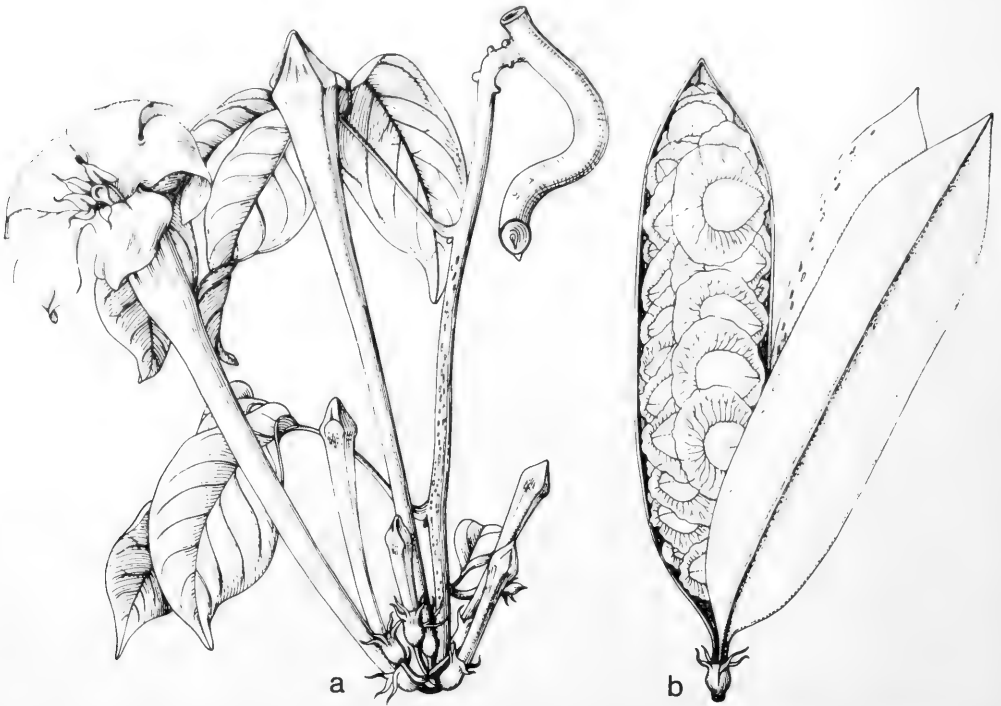


Fig. 1. *Nyctocalos cuspidata* (BL.) MIQ. a. Habit, in flower, b. fruit, opened, showing seeds and dissepiment, $\times \frac{1}{2}$ (after MIQUEL, 1867)

parallel edges, valves with a central prominent rib; dissepiment thinnish, flat. *Seeds* flimsy winged, roundish.

Distr. Three *spp.* in SE. Asia (Assam, Burma, Thailand, Yunnan) and *West Malesia* (Java, Borneo, Celebes, and the Philippines). Fig. 3.

Ecol. Rare rain-forest lianas at low altitude.

Taxon. The genus stands isolated in the Old World flora. In many aspects the small New World genus *Tanaecium* Sw. is very similar, but in this genus at least part of the leaflets carries a terminal tendril; besides its fruit is not flat, but said to be cylindric or quadrangular with convex woody valves. Still I believe it to be an ally in the New World. There is also a similar resemblance with the monotypic South American genus *Macranthisiphon* BUREAU but that has 2-ranked ovules and a more elongate, funnel-shaped corolla tube.

For a moment I thought that *Nyctocalos pinnata* STEEN. (from Yunnan, only known in fruit, *l.c.* 1953, 306) might belong to *Hieris*, but the very numerous seeds defeat this, as far as *H. curtisii* is concerned. *Hieris* is, of course, the most intimate related genus, with the same punctate glands on the leaves and a deceptively similar calyx; its pollen is quite different.

Too much importance has been ascribed to the structure of the androecium: 5 equal stamens to 4 didynamous; this varies as is explained under *N. cuspidata*. It led SEEMANN (*l.c.*) even to the inclusion of the Australian *Hausmannia jucunda* into the genus, which belongs in fact to the *Tecomeae* with quite different fruit and valvate corolla lobes.

Nomencl. The generic name is female, being derived from the Greek *nux*.

KEY TO THE SPECIES

1. Corolla tube c. 15–16 cm long, white. Calyx teeth horn-like, with a linear apex. Lateral petiolules 5–12 mm. 1. *N. cuspidata*
1. Corolla tube c. 5–6 cm long, tinged palish yellow suffused with pinkish shade. Calyx teeth triangular, acute. Lateral petiolules 2–3 mm 2. *N. brunfelsiiflora*

1. *Nyctocalos cuspidata* (BL.) MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 249, t. 8B ('*cuspidatum*'); MERR. Philip. J. Sc. 1 (1906) Suppl. 237; C. B. ROB. *ibid.* 6 (1911) Bot. 211; MERR. En. Philip. 3 (1923) 443; STEEN. Thesis (1927) 813, incl. var. *oblongum* STEEN.; Bull. Jard. Bot. Btzig III, 10 (1928) 180; SANTISUK, Kew Bull. 28 (1973) 183. — *Tecoma cuspidata* BL. Rumphia 4 (1849) 35. — *N. macrosiphon* T. & B. Cat. Hort. Bog. (1856) 155, *nomen*. — *N. brunfelsiaeflorus* (non T. & B.) MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 201, *pro specim. celeb.* — *N. thomsonii* HOOK. f. Bot. Mag. 93 (1867) t. 5678; CLARKE, Fl. Br. Ind. 4 (1884) 377; STEEN. Thesis (1927) 809; Bull. Jard. Bot. Btzig III, 10 (1928) 180; SANTISUK, Kew Bull. 28 (1973) 183. — *Gelseminum cuspidatum* O. K. Rev. Gen. Pl. 2 (1891) 479. — *N. assamica* HOOK. f. ex. K. SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 221, *nomen lapsus*. — Fig. 1-2.

Leaflets elliptic, ovate, obovate, or narrow oblong, rounded at base, acuminate to cuspidate at apex, 6-11(-18) by $3\frac{1}{2}$ -7(-10) cm; petiole 3-5 cm; rachis $2\frac{1}{2}$ -3 $\frac{1}{2}$ cm; petiolules $\frac{1}{2}$ -1 cm. Pedicels c. $\frac{1}{2}$ -1 cm. Calyx c. 6 mm. Corolla in bud pale green, later creamy, the tube c. 15-19 cm; dilated part c. 3-6 cm; lobes rounded, c. $1\frac{1}{2}$ -2 cm. Stamens 4, didynamous, with or without a filiform rudimentary 5th one; anther-cells 6-10 mm; connective with a filiform appendage 2-3 mm. Capsule 16-24 by $3\frac{3}{4}$ -4 $\frac{3}{4}$ cm. Seeds (including the flimsy wings) rounded to obovate, 3-4 by 2-3 cm.

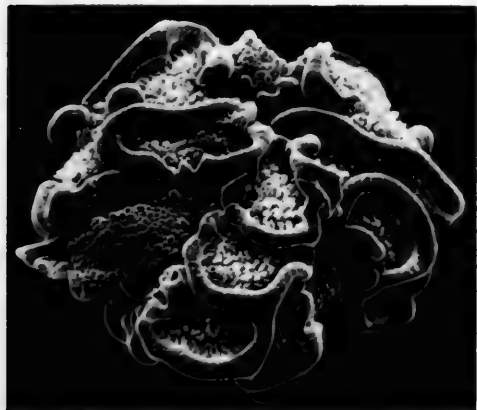


Fig. 2. *Nyctocalos cuspidata* (BL.) MIQ. Pollen grain, SEM $\times 500$ (BS 10396).

Distr. SE. Asia (Assam: Mikir & Gowhaty Hills) and Central Malesia: Philippines (Luzon, Polillo, Palawan, Biliran, Mindanao, Basilan) and Celebes (Manado, Kema, Bantaeng). The type was said to have been collected in the Moluccas by ZIPPEL but this must be doubted. Fig. 3.

Ecol. Lowland rain-forests.

Notes. Hitherto importance was laid in keys on the difference between *N. cuspidata* and *N. thomsonii* in that the former was described with 5 fertile stamens and the latter with 4 didynamous

stamens and a filiform rudiment. This was suspicious as there were hardly any other differences. In material on spirit of Celebes specimens cultivated in Hort. Bog. I have now found flowers with didynamous stamens whether or not accompanied by a staminode. Furthermore, in RIEDEL *s.n.* from Manado and in BS 10396 from Polillo there are 5 perfect stamens; but even here in one flower the two anterior stamens were somewhat longer than the others. There is thus variation in the degree of tendency to zygomorphism. This is also visible in the difference in size of the corolla lobes of which one is mostly larger than the others. The taxonomical implication is the reduction of *N. thomsonii*.

In the Malesian specimens the calyx teeth appear to be somewhat longer and more horn-like than in the Assam specimens depicted by HOOKER f.

2. *Nyctocalos brunfelsiiflora* T. & B. in Miq. J. Bot. Néerl. 1 (1862) 367 ('*brunfelsiaeflorus*'); MIQ. Choix (1863) t. vii; Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 201, *excl. syn. et specim. celeb.*; *ibid.* 3 (1867) 248, t. 8A; STEEN. Thesis (1927) 811; Bull. Jard. Bot. Btzig III, 10 (1928) 179 ('*brunfelsiiflorus*'); Acta Bot. Néerl. 2 (1953) 306; BACK. & BAKH. f. Fl. Java 2 (1965) 536; SANTISUK, Kew Bull. 28 (1973) 183. — *N. shanica* MACGREGOR & W. W. SMITH, Rec. Bot. Surv. India 4 (1911) 280; STEEN. Thesis (1927) 811; SANTISUK, Kew Bull. 28 (1973) 182, 183; Thai For. Bull. Bot. 8 (1974) 88.

Leaflets elliptic, oblong, or obovate, acuminate to cuspidate, 7-13 by 3-6 cm; petiole 4-7 cm; rachis $1\frac{1}{2}$ -3 cm; petiolules 1-2 mm. Racemes 5-10-flowered. Pedicels 1-1 $\frac{1}{2}$ cm. Calyx 5-6 mm, suffused with reddish tinge in anthesis (*ex coll.*). Corolla whitish afterwards yellowish, later apically suffused with pink; tube 5-7 cm, the dilated part some 2-2 $\frac{1}{2}$ cm; lobes rounded to obovate or truncate, c. 2 cm. Stamens (so far as known) 5, fertile, equal or subequal. Capsule 10-13 by 3-4 cm,

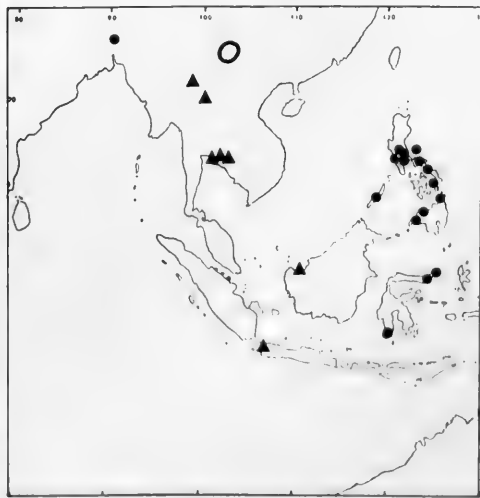


Fig. 3. Range of the genus *Nyctocalos* T. & B.: *N. brunfelsiiflora* T. & B. (triangles), *N. cuspidata* (BL.) MIQ. (dots), and *N. pinnata* STEEN. (circle).

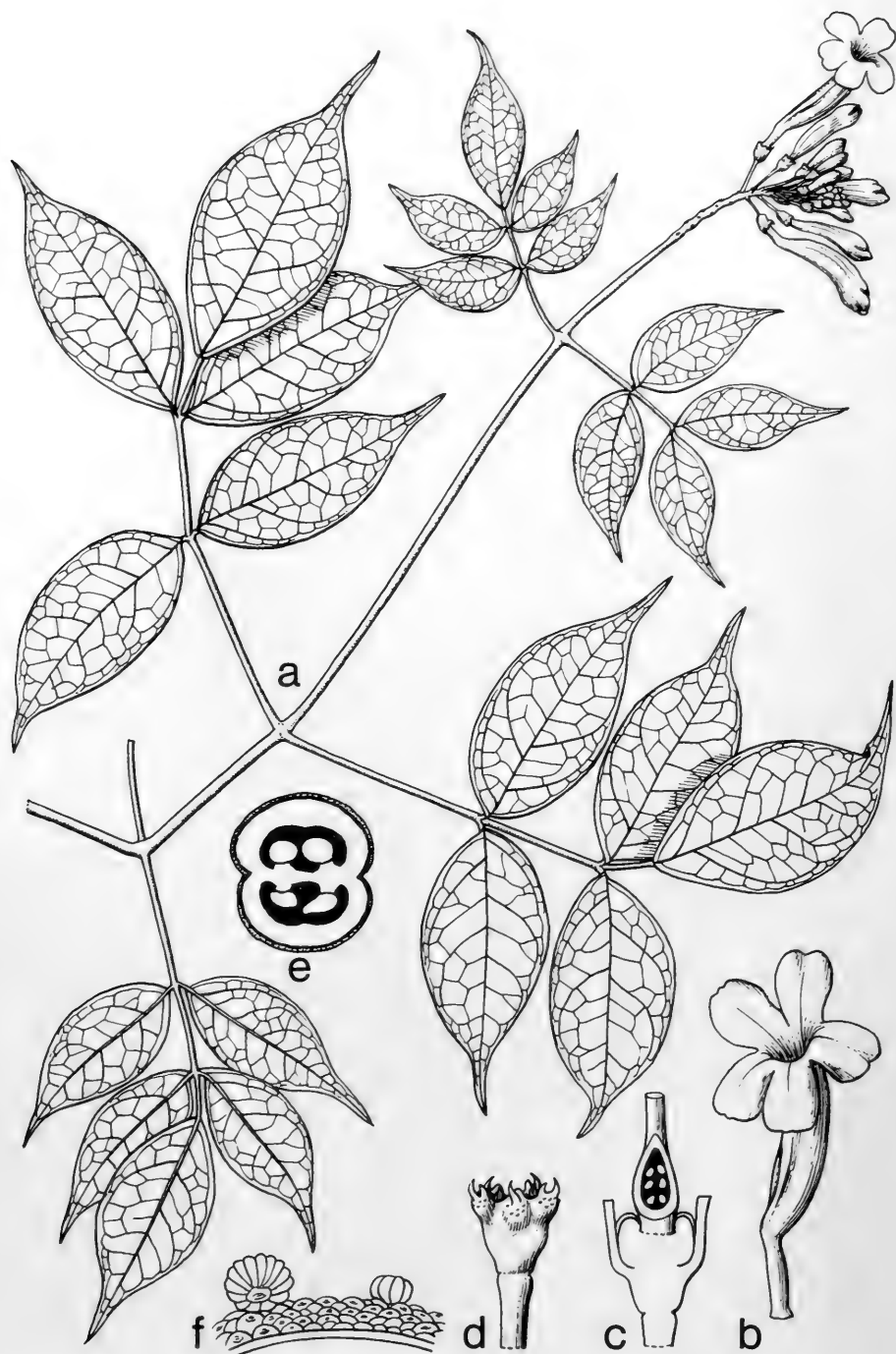


Fig. 4. *Hieris curtisii* (RIDL.) STEEN. a. Habit, $\times \frac{1}{2}$, b. corolla, nat. size, c. LS of ovary, disk and receptacle, $\times 2\frac{1}{2}$, d. calyx, $\times 2\frac{1}{2}$, e. CS of ovary, $\times 7\frac{1}{2}$, f. glands on ovary (HENDERSON s.n.).

Distr. SE. Asia (Upper Burma: S. Shan States; Thailand: N. & SE.), in *Malesia*: Borneo (Sabah, near Kudat; Sarawak, near Niah), SW. Java (Wijnkoops Bay). Fig. 3.

Ecol. Lowland rain-forests, even in Burma below 300 m.

Uses. TEYSMANN found it a beautiful ornamental; as far as nocturnally flowering plants can be. He could easily propagate it by marcottes. VAN HASSELT (*in sched.*) noted that in SW. Java crushed leaves are rubbed against head and stomach aches.

Vern. *Kakatjangan*, S. SW. Java.

Notes. *N. shanica* was distinguished by having glabrous anthers; these had in *N. brunfelsiiflora* been described and depicted as hairy to the base. This is, however, a lapsus: the base of the filaments and tube in the vicinity of the insertion is only dotted with small sessile granular glands. SANTISUK

(*l.c.*) said that the pollen would be different from that of *N. shanica*, but I cannot accept this for specific distinction. The colour of *N. shanica* was described as white, but field data enumerated by SANTISUK mention also creamy white, buds purplish, and pale yellow flowers. Of *N. brunfelsiiflora* MIQUEL mentioned them to be pale pinkish 'tirant légèrement vers le jaune', more purplish to anthesis. BACKER said: corolla at first white, afterwards yellowish; tube apically suffused with red. I do not ascribe much importance to these faint colour variances, especially nocturnal flowers often discolour with age.

In comparing the scanty flowering material of both species it seems that in *N. shanica* the widening of the corolla tube starts lower than in *N. brunfelsiiflora*, but I can not accept this for specific distinction.

2. HIERIS

STEEN. Bull. Jard. Bot. Btzig III, 10 (1928) 279, f. 13. — Fig. 4.

Slender woody twiner. *Leaves* 1-pinnate, with (1–)2(–3) pairs of entire leaflets. *Racemes* (?axillary or) terminal. Pedicels bracteolate. *Flowers* scattered. *Calyx* cupular, articulated with the pedicel, short- or indistinctly 5-lobed, just below the margin with 5 spur-like, upcurved teeth at the base of each lobe, each tooth with a few glands on each side of its base. *Corolla* zygomorphic, the basal narrowed tube c. $\frac{1}{3}$ of its length, \pm geniculate with the upper $\frac{2}{3}$ which is widened, flattened, and gently curved; lobes subequal, suborbicular, finely capitate-glandular, papillose-hairy outside at base. *Stamens* 4, didynamous, inserted at the end of the basal tube, included, 5th rudimentary; anthers connivent in pairs, divaricate, connective apiculate. Disk entire, pulvinate-annular, fleshy. *Ovary* ovate, subterete, with 2 grooves, microscopically glandular; ovules in \pm two rows of 3–4 in each cell.

Distr. Monotypic. *Malesia*: Malaysia: Penang I. (near village on north coast).

Taxon. Outstanding by the few ovules and the geniculate tube of the corolla. The structure of the inflorescence seems to be racemose though flowers are articulated.

Notes. Unfortunately the fruit and seed of this most interesting plant is unknown; from the cross-section of the ovary one might assume it to belong to tribe *Bignonieae* as the grooves of the ovary correspond with the edges of the septum, while furthermore the calyx structure is a replica of that of *Nyctocalos*, with which genus it seems closest related. In *Nyctocalos*, however, there is a very large number of ovules in each cell, which are very few in the Penang plant, like in the South American genus *Memora*. By the pinnate leaves *Hieris* shows resemblance with *Nyctocalos pinnata* STEEN. from Yunnan, which is unfortunately only known in fruit, but has abundant seeds in each cell.

Mr J. MÜLLER told me (Febr. 1975) that the pollen of *Hieris* is not in the least resembling the showy pattern of *Nyctocalos*.

1. *Hieris curtisii* (RIDL.) STEEN. Bull. Jard. Bot. Btzig III, 10 (1928) 280, f. 13. — *Tecoma curtisii* RIDL. J. As. Soc. Str. Br. 49 (1908) 26. — *Pandorea curtisii* RIDL. Fl. Mal. Pen. 2 (1923) 553, f. 125; STEEN. Nova Guinea 14 (1927) 301; Thesis (1927) 846, f. 4(2). — Fig. 4.

Glabrous. Twigs terete, with very many small lenticels; nodes with glands and a dark transversal line. *Leaves* (10–)15–20 cm long; petiole $2\frac{1}{2}$ –8 cm; rachis c. 4–5 cm; petiolules of lower pair of leaflets 4–12 mm, of upper pair (0–)1–2 mm. Leaflets herbaceous, slightly unequal-sided, ovate-oblong, long-acuminate, 5–8 by 2–3 cm; nerves 4–5 pairs;

undersurface with scattered, small, rimmed-crateriform glands, upper surface with microscopical pitted-punctate glands. Rachis rather densely flowered, microscopically puberulous, 2–7 cm; peduncle 2 cm, with barren bracts. Bracts linear, 2 mm. Pedicels thin, 5–8 mm, with 1–2 minute bracteoles in the lower half. *Calyx* 6 mm, purplish, bluntly 5-ribbed, inside with dark red microscopical capitate-glandular hairs. *Corolla* $4\frac{1}{2}$ –5 cm, tube yellow, lobes whitish turning pale lilac, c. 1 cm \varnothing , 2 upper recurved, 3 lower erect; outside on transition of tube and lobes scattered, rather large, brown red glands; basal tube $1\frac{1}{2}$ cm by 2 mm,

near the insertion of the stamens scattered microscopical red-tipped, capitate-glandular hairs as in the calyx tube. *Filaments* glabrous, 12 and 14 mm; rudiment 5 mm, with reflexed apex; anther-cells $2\frac{1}{2}$ mm, connective appendage linear, 1 mm. *Ovary* elliptic $1\frac{1}{2}$ by 1 mm; style 2 cm; stigmatic lobes elliptic, $1\frac{1}{2}$ mm.

Distr. *Malesia*: Penang I., see above.

Ecol. Not well noted, 3 collections, all from 1898-1902; fl. June, July, Nov., and a cultivated specimen in Hort. Sing., Lawn 0, in Febr.

3. OROXYLUM

VENT. Dec. Gen. Nov. (1808) 8; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 225 ('*Oroxylon*'), l.c. 212 in *clavi*; STEEN. Thesis (1927) 816; Bull. Jard. Bot. Btzig III, 10 (1928) 181. — *Calosanthus* BL. Bijdr. (1826) 760; DC. Prod. 9 (1845) 177; BUREAU, Mon. (1864) 45, t. 9. — *Hippoxylon* RAFIN. Sylv. Tellur. (1838) 78, *nom. illeg.* — Fig. 5, 7.

Glabrous tree, robust in all its parts. *Leaves* 2-3(-4)-pinnate, all nodes with in sicco shrinking articulations; leaflets entire. *Flowers* very large, fetid, nocturnal, in large terminal racemes (by exception in a thyrese). *Calyx* persistent, not articulated, coriaceous, closed in bud, with a fine apical pore, later opening campanulate, \pm entire. *Corolla* funnel-shaped, lobes 5, subequal, imbricate in bud. *Stamens* 5, subequal, all fertile; anthers 2-celled, cells free, \pm parallel. *Ovary* with ∞ rows of ovules in both cells. *Capsule* flat, very large, sword-shaped, linear; dissepiment flat, coriaceous. *Seeds* large in ∞ rows; insertion linear, 1 cm wide.

Distr. Probably monotypic. From Ceylon, the Deccan and Himalayas through SE. Asia (also in S. China: Yunnan, Kwangsi, Setchuan, Kweichow) and *Malesia* eastwards to the Philippines, Celebes, and Timor. Fig. 6.

Ecol. A characteristic, short-lived nomad tree, nowhere gregarious, not in mature rain-forest but always in openings, secondary growths and thickets, rather indifferent to climate (also in teak forest under seasonal conditions) and soils, mostly below 1000 m, but in S. China up to 1375 m (HANDEL-MAZZETTI).

Taxon. A second species has been described, raised from seed, collected by A. HENRY in Yunnan, in 1889, in the Arnold Arboretum, and named *O. flavum* REHDER (in Sargent, Trees & Shrubs 1, 1904, 193, t. 92). REHDER discriminated this from *O. indicum* chiefly by the sulphur yellow colour of the nearly symmetrical flowers, the plain not toothed or crisped corolla lobes, the splitting calyx, and the oblong leaflets.

Several of these characters are not valid, especially if we take into consideration that REHDER's plant was an unbranched sapling of 3 m high. In such saplings the leaves are always somewhat longer and thinner. The sulphur-yellow corolla is also rarely found in *O. indicum* from where I described it (1928) as *var. citrinum* STEEN. on a cultivated specimen at Bogor so annotated by J. J. SMITH (C.H.B. XV.K.B.IX-11). The calyx is indeed different from that in *O. indicum*, in being thinner and having 5 faint ribs, but it is lobed by tearing, and this is also sometimes found in fruiting specimens of *O. indicum*. The corolla in *O. flavum* is also regular and somewhat smaller than usual but an examination of the type showed an exactly similar occurrence of hairs at the anther bases, the patelliform glands outside and the granular-glandular hairs inside. Remains the plain, entire corolla lobes, and an other character figured by REHDER but not mentioned by him, *viz* that the inflorescence is not a raceme, but a thyrese, with the lower stalks 5-flowered in double triads and the upper ones in simple triads, a situation never recorded or seen by me in *O. indicum*. I cannot well account for these two differences, but they could be due to cultivation; in our experience tropical plants in hothouses often deviate from those in the wild, certainly in first-flowering saplings.

1. *Oroxylum indicum* (L.) KURZ, Fl. Burma 2 (1877) 237; CLARKE, Fl. Br. Ind. 4 (1884) 378; K. & V. Bijdr. Booms. 1 (1894) 66, Atlas 2 (1914) t. 358; RIDL, Fl. Mal. Pen. 2 (1923) 548; MERR. En. Philip. 3 (1923) 444; STEEN. Thesis (1927) 816; Bull. Jard. Bot. Btzig III, 10 (1928) 181, *incl. var. citrinum* STEEN. l.c. 184; OCHSE & BAKH. Ind. Groent. (1931) 77, f. 46; HAND.-MAZZ. Symb. Sin. 7 (1936) 888; CORNER, Ways. Trees (1940) 166, Atlas t. 29. — *Palega-pajaneli* RHEEDE, Hort. Mal. 1 (1686) 77,

t. 43. — *Bignonia indica* var. α LINNÉ, Sp. Pl. (1753) 625; ROXB. Fl. Ind. ed. Carey 3 (1832) 110. — *Bignonia pentandra* LOUR. Fl. Coch. 2 (1790) 379. — *Bignonia tripinnata* NORONHA, Verh. Bat. Gen. 5 (1790) art. 4, p. 8, *nomen*. — *Spathodea indica* PERS. Syn. 2 (1807) 273. — *Calosanthus indica* BL. Bijdr. (1826) 760; WIGHT, Ic. Pl. 4 (1850) t. 1337-1338; MIQ. Fl. Ind. Bat. 2 (1858) 752; BUREAU, Mon. (1864) 45, t. 9. — *Bignonia quadripinnata* BLANCO, Fl. Filip. (1837) 499, ed. 3, t. 219. —



Fig. 5. *Oroxylum indicum* (L.) KURZ, the 'midnight horror'. Pole on left is a sapling that has flowered and fruited and is temporarily leafless. Different branches of the same tree may be in leaf, flower or fruit at the same time (Tg. Bukit, Sg. Sedili Ketchil, photogr. CORNER, June 1934).

Hippoxylum indicum RAFIN. Sylv. Tellur. (1838) 78, nom. illeg. — *Arthrophyllum ceylanicum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 27. — *Arthrophyllum reticulatum* BL. ex MIQ. l.c., et corr. 318. — Fig. 5, 7.

Smallish, glabrous, sparingly branched, semi-deciduous tree, 6–20(–27) m; trunk 10–40 cm Ø, with grey bark and large leaf-scars; twigs thick, (as the trunk at least at apex) pithy, later hollow, lenticellate, as the leaf-rachis. Leaves tufted at twig-ends, with a long petiole, $\frac{1}{2}$ –2 m; leaflets long petioled, ovate to oblong, acuminate, 4–11(–15) by 3–9 cm, cuneate, rounded or reniform at the trip-
linerved mostly oblique base, underneath distinctly

reticulate-veined, with some scattered gland fields near the axils of the nerves and scattered, microscopical scales. Innovations of leaves and racemes viscid. Racemes terminal, erect, $\frac{1}{4}$ – $1\frac{1}{2}$ m long, pith of twig-apex, peduncle and rachis partitioned. Pedicels long, with a few bracteoles in lower part, 2–4 cm. Calyx coriaceous, becoming almost woody in fruit, containing water in bud, truncate or irregularly shallow lobed by tearing, campanulate, brown or dirty-violet, 2–4 by $1\frac{1}{2}$ –2 cm. Corolla reddish purple to liver-brown to dirty violet outside, dirty yellowish to pinkish inside, with a foxy stench, 7–10 cm long, the lobes subequal, in young buds strongly folded into a massive apex, ±

crisped or undulate-crenate, in flower patent to \pm reflexed, outside with scattered patelliform glands, the lobes inside with dense, almost sessile capitate gland-hairs; basal tube wide, widened to base, c. $1\frac{1}{2}$ cm. *Stamens* inserted in throat, their base long hairy. *Style* 4–6 cm, dark violet as the sub-entire, large disk. *Capsule* pendent, 45–120 by 6–10 cm, valves flat, almost woody, finally black. *Seeds* incl. wings 5–9 by $2\frac{1}{2}$ –4 cm.

Distr. As the genus. Fig. 6.

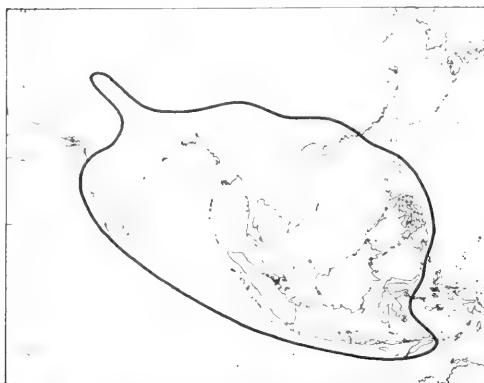


Fig. 6. Range of the genus *Oroxylum* VENT.

Ecol. As the genus. As a consequence of its short-lived, short-sized nomad habit relatively rare in tracts with largely high primary forest, e.g. Borneo. In Malaya chiefly by villages and by rice-fields (CORNER). Also not particularly common in open but seasonally very dry tracts, such as the Lesser Sunda Is. and in teak forest largely confined to mixed forest stands. *Fl.* Jan.–Dec., according to KOORDERS in Java at the start of the dry season; *fr.* July–May, the fruit remaining during the dry season on often leafless stems.

CORNER (*l.c.*) gave a lively account of his observations on this grotesque treelet. He remarked: "that each leaf develops as a unit and when it withers it breaks up gradually in regular order from the tip to the base: the leaflets fall off singly and the main stalk and its side-stalks break up at the joints: the bits accumulate round the base of the trunk like a collection of limb-bones, so that we may call it the 'Broken Bones Plant'. The leaves are crowded near the end of the stem or its branches, and saplings, which remain unbranched until after their first flowering at a height of some 15 ft., look like gigantic umbrellas. When the saplings flower, the inflorescence develops from the apical bud and therefore further upward growth of the main stem is prevented. When the inflores-

cence has finished flowering, the leaves below it fall off and the leafless stem is left as a pole with a few sabre-like pods dangling from its extremity: wherefore, we may call it the 'Tree of Damocles'. Then, after 3–4 weeks in a leafless state, one or more lateral buds on the stem break out and grow into side-branches which, in due course, flower, fruit, shed their leaves and branch in their turn: and, thus, the big trees are constructed sympodially with open irregular crown and a few lanky ascending limbs. Each branch seems to flower independently of the others so that flowers, fruits and growing twigs may be found on the same tree."

Flower biology. The flowers are nocturnal; on each raceme 1–2 flowers open on one night. According to CORNER (*l.c.*): "The corolla begins to open about 10 p.m., when the tumid, wrinkled lips part and the harsh odour escapes from them. By midnight, the lurid mouth gapes widely and is filled with stink. Before sunrise the corolla is detached and slips off over the long style. The flowers are pollinated by bats which are attracted by the smell and, holding to the fleshy corolla with the claws on their wings, thrust their noses into its throat: scratches, as of bats, can be seen on the fallen flowers of the 'Midnight Horror' next morning." Fig. 7.

Dispersal. The gauzy seeds slip out of the opened pods and flit away on the breeze with the jerky motion of a butterfly: so in noon-tide, we may call the tree the 'Midday Marvel' (CORNER, *l.c.*).

Uses. Popular with the Sundanes as a vegetable (*lalab*), fresh young leaves and flowers; even unripe capsule valves are eaten after being cooked (HASSKARL).

In Bawean I. flowers are used against inflammation of the eyes. The bitter bark is chewed in Java for depurative purpose, especially after delivery.

In Sarawak used for dyeing rattan of black shiny baskets.

In West Java (Priangan) local people are convinced that the tree is a protection of the house against thieves, a superstition probably derived from the sword-like shape of the capsules.

Vern. *Midnight horror*, E; Malaya: (*beka*) *kampong*, *blalai*, *blonglai* (*kaya*), *bulai kaju*, *kain*, *merlai*, *poko bulai*, Malacca; Sumatra: *bolai*, Minangkabau, *habreng*, Atjeh, (*ka*)*kapung*, M, S. Sum., *mēnglěo*, Simalur I., *abang-abang*, Asahan; Borneo: *gimurai*, Sarawak, Bidayan name; Java: *ki tongtorang*, *pongpor(r)ang*, S, (*kayu*) *lanang*, *mungli*, *wongli*, *wungli*, J, *pedangan*, Japara, *dělēg*, *kadjēn djalēr*, *kěok*, *padangan*, *raon*, J (all once noted), *bunglo*, *punglo*, Md; h. *lema kaba*, *kowa*, Flores; Celebes: *buli*, Bantaeng, *pohon padang*, Manado; *karu kadang*, *kayu*, Kutai; Philippines: *balilang-uak*, *pingka-pingka*, *p-pinkahan*, *taghilau*, Tag., *abang-abang*, P.Bis., *abong-abong*, Bis., *sakayan-bakus*, Tagb., *balay-uak*, *bunglui*, Sul., *baliuag*, *bungoi*, C.Bis., *banloi*, Sub., *barañgau*, *kamkampilan*, Ilk., *kampilan*, Neg., *maidbaid*, Bik.

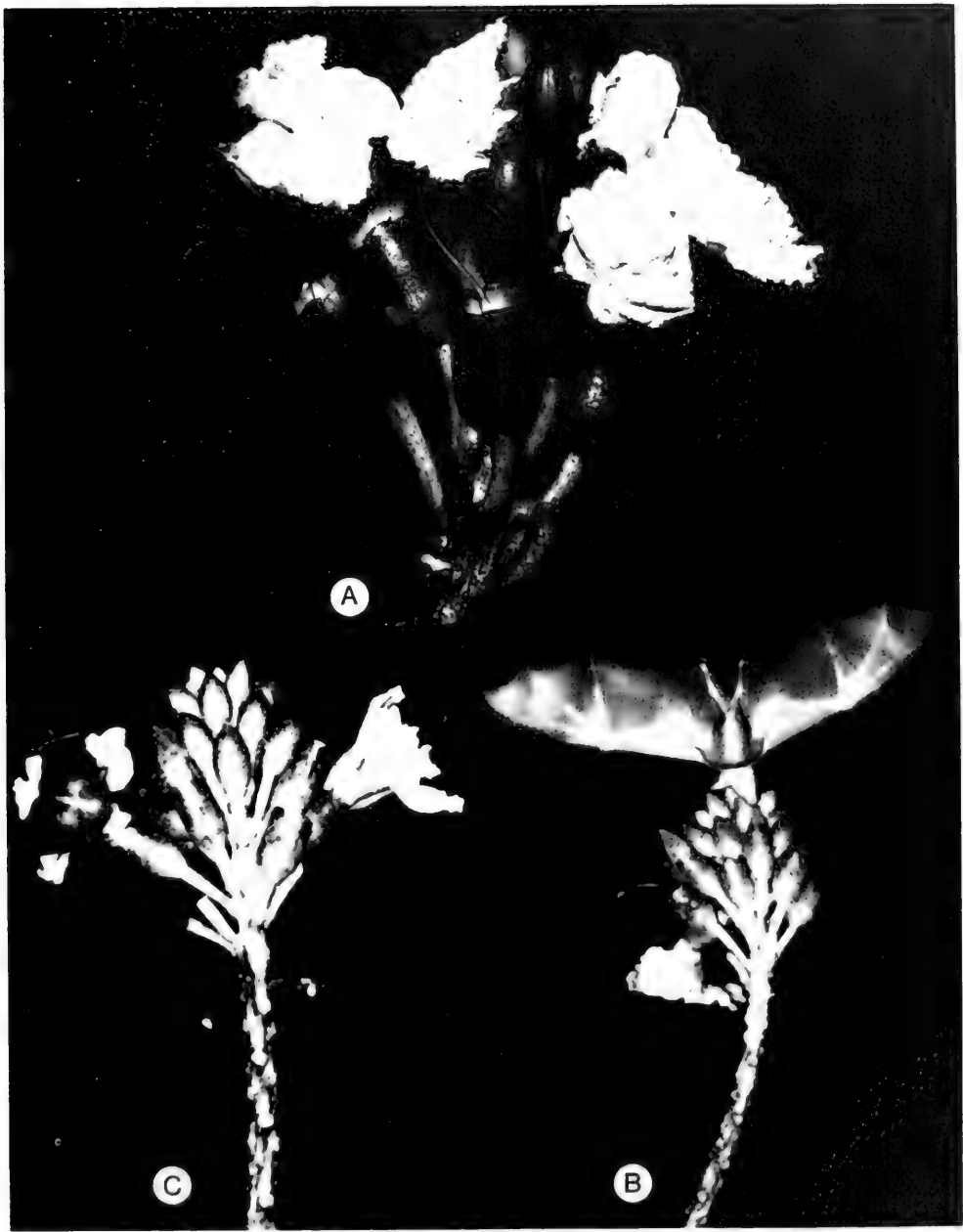


Fig. 7. *Oroxylum indicum* (L.) KURZ. a. Top of raceme with two open flowers, $\times \frac{1}{2}$, b. bat arriving on a flower, c. landed bat on a flower sucking honey (Old Bot. Garden, Univ. Malaya, Kuala Lumpur, photogr. SOEPADMO, Sept. 1973, 9.30 p.m.).

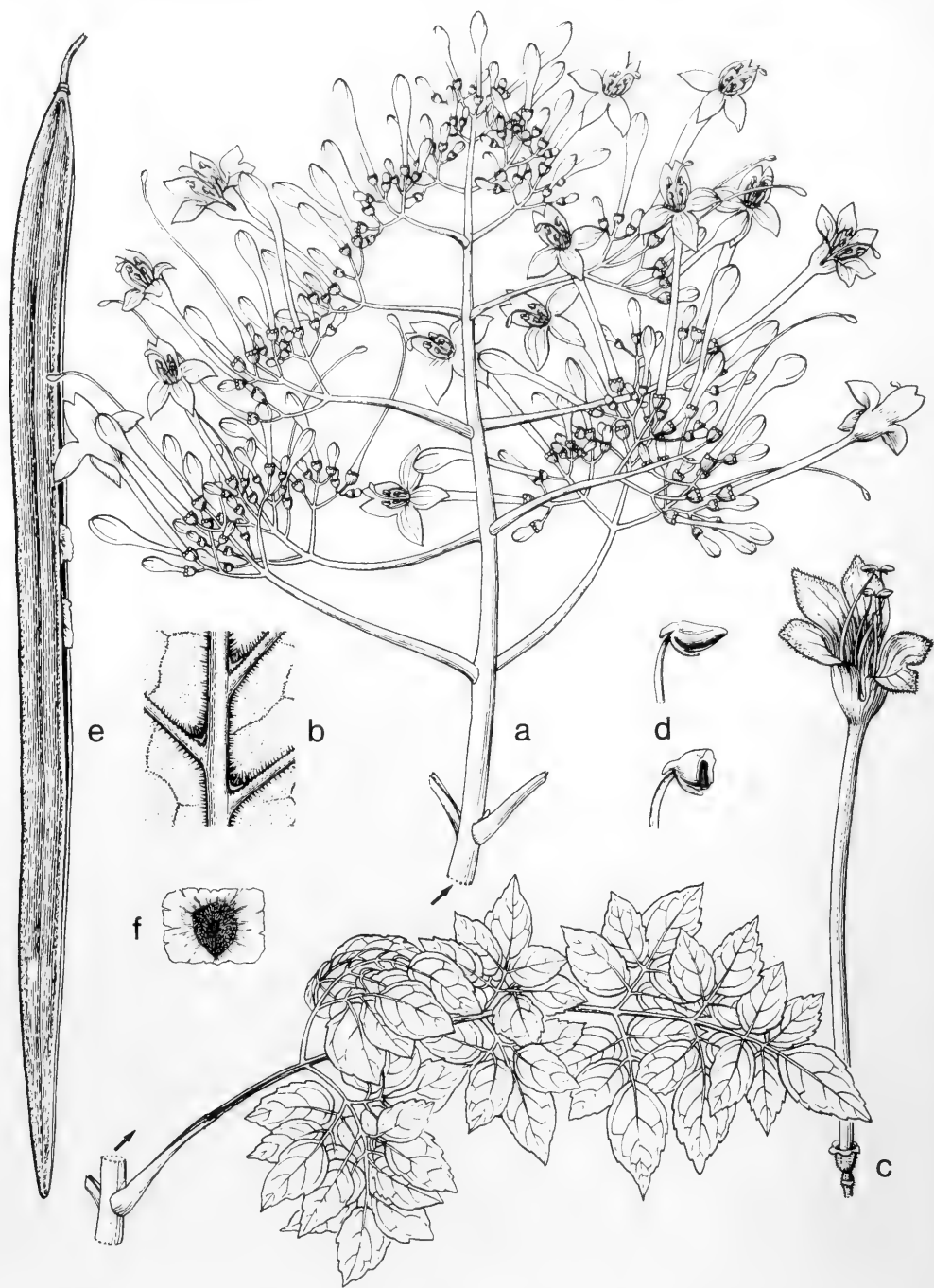


Fig. 8. *Millingtonia hortensis* L. f. a. Habit, $\times \frac{1}{2}$, b. detail of underside of leaflet, showing domatia, $\times 5$, c. flower, nat. size, d. anthers, one in CS, e. capsule, $\times \frac{1}{2}$, f. seed, nat. size (a after WALLICH, c-d after BUREAU, b, e-f SPANOGHE s.n. TIMOR).

4. MILLINGTONIA

LINNÉ *f. Suppl.* (1781) 45, 291, *non* DONN, 1807, *nec* ROXB. 1820; K. SCH. in E. & P. *Nat. Pfl. Fam.* 4, 3b (1894) 226, f. 89 j-k; STEEN. *Thesis* (1927) 825; *Bull. Jard. Bot. Btzig III*, 10 (1928) 186. — *Nevrilis* RAFIN. *Sylv. Tellur.* (1838) 138, *nom. illeg.* — **Fig. 8.**

Medium-sized evergreen or deciduous tree with corky bark. *Leaves* 2-3-pinnate, with domatia. *Thyrse* lax, ∞-flowered, terminal. *Flowers* white, fragrant, nocturnal. *Calyx* small, truncate-campanulate, ± 5-lobed, persistent. *Corolla* salver-shaped, glabrous, with a very long, slender, basal tube at apex widening towards the limb, limb at base short funnel-shaped, zygomorphic (± 2-lipped), 5-lobed, imbricate in bud. *Stamens* 4, didynamous, glabrous, inserted at the base of the widened part of the tube (throat), shortly exerted, no staminode; anthers with 1 fertile cell, the other spur-like, barren; connective dorsal, swollen. *Disk* cup-shaped, crenate. *Capsule* linear, compressed parallel to the septum, septicid-dehiscent, valves flat. *Seeds* ∞, thinly discoid, winged.

Distr. Monotypic. SE. Asia (India, Burma, Thailand, Indo-China, Yunnan) and *Malesia*: probably native, in E. Java, Madura and Kangean Is., Lesser Sunda Is. (Bali, Sumbawa, Sumba, Flores, Timor), and S. Celebes (SW. Peninsula; Muna I.), in many places also cultivated (Penang, Sumatra, Java, *etc.*) and in dry areas running wild, may be wild also in N. Malaya (Perlis and Kedah, CORNER, *l.c.*). **Fig. 9.**

Ecol. Lowland monsoon forest.

1. *Millingtonia hortensis* LINNÉ *f. Suppl.* (1781) 291; DECNE, *Herb. Timor.* (1835) 32; SPAN. *Linnaea* 15 (1841) 326; MIQ. *Fl. Ind. Bat.* 2 (1858) 753; BUREAU, *Mon.* (1864) 45, t. 8; F.-VILL. *Nov. App.* (1880) 150, cult. Manila; CLARKE, *Fl. Br. Ind.* 4 (1884) 377; K. & V. *Booms. Java* 1 (1894) 65; STEEN. *Thesis* (1927) 826; *Bull. Jard. Bot. Btzig III*, 10 (1928) 187; CORNER, *Ways. Trees* (1940) 165; MERR. *J. Arn. Arb.* 25 (1944) 316; BACK. & BAKH. *f. Fl. Java* 2 (1965) 234. — *Bignonia suberosa* ROXB. *Cor. Pl.* 3 (1811) 11, t. 214, *nom. illeg.* — *Bignonia cicutaria* MART. *Denkschr. K. Ak. Wiss. München* 6, Kl. *Math. Phys.* (1820) 153, t. D. — *M. dubiosa* SPAN. in Hook. *Comp. Bot. Mag.* 1 (1835) 348, *nomen.* — *Nevrilis suberosa* RAFIN. *Sylv. Tellur.* (1838) 138, *nom. illeg.* — **Fig. 8.**

Evergreen (or deciduous?) tree, 5-25 m, to 30 cm Ø; bark corky, very rough, cracking; twigs lenticellate. Mature *leaves* herbaceous, nearly glabrous, 3-5-jugate, lower pairs pinnate, up to 1 m; leaflets ovate-lanceolate, acuminate, sinuate or crenate, or entire, 2½-6 by 1½-3 cm; domatia haired. *Thyrse* erect, 10-40 cm, puberulous, flowers fragrant, only few open at a time. *Calyx* 2-4 mm, teeth short, broad, obtuse, margin revolute. *Corolla* tube 6-8 cm by 2 mm, widened to mouth, limb 4-5 cm Ø, lobes ovate, acute, outside with crateriform glands, c. 1½ cm. *Filaments* c. 10 and 14 mm long; anthers 2 mm, with a small appendage at the base. *Style* to 8 cm long. *Stigmatic lobes* ovate-acute, 1½ mm. *Capsule* 30-35 by 1½-1¾ cm. *Seeds* thin-discoid, 1½-3½ by 1-1½ cm including the wings.

Distr. As the genus. **Fig. 9.**

Ecol. A characteristic tree of regions subject to annual drought ('monsoon flora'), companion of teak, fire-resistant by its thick corky bark and pro-

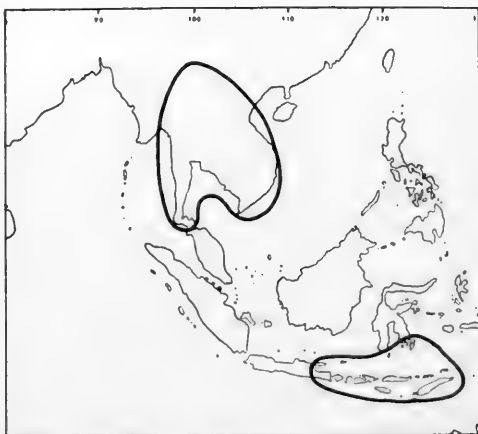


Fig. 9. Range of *Millingtonia* L. f.; delimitation in Asia is slightly arbitrary.

fuse capacity of suckering from roots, below 750 m alt. In Timor common in *Ziziphus* stands (MEIJER DREES). *Fl.* Jan.-Sept., mostly June.

Father SCHMUTZ reported that it is in Flores not deciduous; flowers appear at the end of the dry season, before the first rains set in.

Uses. The soft, even-grained timber was sometimes advertized for tea-boxes but is not of high quality. Tree sometimes used for parks or roadsides, leaves as a poor substitute of opium in cigarettes, sometimes received from the opium factory in Java under the vernacular name *gendjè*.

Vern. *Indian cork tree*, E, *kurkboom*, D, *kahombu*, M (Sum.), *amfunan*, *sëkar pëtak*, *sëkar putih*, J, *karpoti*, Kangean, *kanongoh*, Bali, *këtarang*, Sumba, *takah*, Dawang lang., Timor, *ai katong inggar*, *takah*, *toka hau*, Timor, *ai kakassa*, Tetun lang., Port. Timor, *katangka*, Bug., Makassar, *kaulolo*, Muna I.

Notes. From Sumba the flowers have once been noted to be red (IBOET 264), never confirmed.

MEIJER DREES (Comm. For. Res. Inst. Bogor 33, 1951, 39) recorded that *Millingtonia* is deciduous in the driest regions of Timor, but the scant field notes do not confirm this.

Tribe 2. Tecomeae

ENDL. Gen. Pl. (1839) 711; FENZL, Denkschr. K. Bay. Bot. Ges. Regensburg 3 (1841) 261; B. & H. Gen. Pl. 2 (1876) 1029; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 209; BUREAU, Fl. Bras. 8, 2 (1897) 300. — *Subtribe Catalpeae* DC. Rév. Bign., Bibl. Univ. Genève (1838) 123; Prod. 9 (1845) 203.

Capsule loculicid, the septum attached transverse to the valves. Mostly trees or shrubs, rarely lianas, by exception with tendrils.

5. TECOMA

JUSS. Gen. (1789) 139; REHDER, Mitt. Deut. Dendr. Ges. 22 (1913) 262; BRITTON, Bull. Torr. Bot. Club 42 (1915) 372; URBAN in Fedde, Rep. 14 (1916) 313; MELCHIOR, Ber. Deut. Bot. Ges. 59 (1941) 18–31. — *Stenolobium* D.DON, Edinb. Phil. J. 9 (1823) 264; SEEM. J. Bot. 1 (1863) 87; STEEN. Thesis (1927) 964; Bull. Jard. Bot. Btzg III, 10 (1928) 217. — *Tecomaria* SPACH, Hist. Nat. Vég. 9 (1840) 137; FENZL, Denkschr. K. Bay. Bot. Ges. Regensburg 3 (1841) 266; SEEM. J. Bot. 1 (1863) 19–23; SPRAGUE, Fl. Cap. 4, 2 (1904) 448; STEEN. Thesis (1927) 831; Bull. Jard. Bot. Btzg III, 10 (1928) 193; BRUMMITT, Bull. Jard. Bot. Nat. Belg. 44 (1974) 421.

Erect or scrambling shrubs or small trees. No gland fields at the nodes. *Leaves* 1-pinnate, sometimes 1-jugate, or more rarely simple; leaf or leaflets incised or serrate, densely microscopically glandular-punctate and with hairy domatia underneath. Pedicel with minute bracteoles. *Flowers* in terminal racemes or more often raceme-like thyrses, yellow, orangish or scarlet. *Calyx* cupular or campanulate, with 5, often apiculate deltoid lobes, glands scattered. *Corolla* tubular, with a short basal tube, funnel-shaped, \pm straight or \pm curved, widened to the mouth, lobes almost equal to unequal, imbricate in bud, minutely ciliate. *Stamens* 4, didynamous, exserted or included; anther-cells divergent, often finally standing out transversally, free or partly connate, sometimes hairy; 5th rudimentary. *Disk* cupular-pulvinate to shallowly cup-shaped. *Ovary* narrow cylindric or oblong, compressed, lepidote; ovules 2–4-seriate in each cell. *Capsule* linear, \pm compressed parallel to septum; valves smooth. *Seeds* hyaline-winged all round, insertion punctiform.

Distr. Some dozen species in the New World, from extreme S. Arizona and S. Florida to northern Argentina, especially in the Andes, and one species in southern Africa. Some species widely cultivated in the tropics and subtropics and one of these locally naturalized in *Malesia*.

Taxon. I can see no sufficient reason to keep *Tecomaria* generically apart from *Tecoma*. It often is said to differ by the exserted stamens and orange-red to scarlet flowers, but it has appeared that among the many taxa of South American *Tecoma* (*Stenolobium*) there are taxa with exserted stamens and in some the flowers are orangish. Inadvertently SEEMANN (J. Bot. 1, 1863, 19–23) also united them, but curiously later distinguished *Stenolobium* (l.c. 87).

According to SPRAGUE (Fl. Cap. 4, 2, 1904, 448) there are only two valid characters, viz the number of the rows of ovules in each cell (2 in *Tecoma*, 4 in *Tecomaria*) and the anthers. As to the first character, in a dozen American genera this number varies, from 2-4, 2-6 and in *Tabebuia* even from 2-many; its value seems therefore to be rather low. The second character holds: in American *Tecoma* the anther-cells are completely free causing them in full anthesis to stand often perpendicular to the filament; in *Tecomaria* they are connate in the upper 3rd or 4th part, so that they can not diverge so widely.

The intimate relationship between *Tecoma* and *Tecomaria* is emphasized by a reputed fertile hybrid, \times *Tecoma smithii* W. WATSON (see p. 118), between *Tecoma velutina* and *Tecomaria capensis*.

As the differences between the genera coincide with the geographical disjunction I am prepared to distinguish them at sectional level and refer *Tecomaria* to *Tecoma* sect. *Tecomaria* (SPACH) ENDL. Gen. Pl. (1839) 71.

From southern Africa 3 spp. were described but F. WHITE (For. Fl. N. Rhod. 1962, 380) and BRUMMITT (Bull. Jard. Bot. Nat. Belg. 44, 1974, 419) distinguish only one.

In South America a thorough revision probably will also show reduction to fewer variable and raciated species.

1. *Tecoma stans* (L.) H.B.K. Nov. Gen. Sp. 3 (1819) 144; DC. Prod. 9 (1845) 224; F.-VILL. Nov. App. (1880) 151; MERR. Fl. Manila (1912) 428; JOHNSTON, Proc. Cal. Ac. Sc. IV, 12, 2 (1924) 1166; SANDWITH in Pulle, Fl. Surinam 4, 2 (1938) 79; CORNER, Ways. Trees (1940) 170, f. 44, pl. 159; BACK. & BAKH. f. Fl. Java 2 (1965) 539; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 958, f. 38, with full synonymy. — *Bignonia stans* LINNÉ, Sp. Pl. ed. 2 (1763) 871; JUSS. Gen. (1789) 139; RECHINGER, Denkschr. K. Ak. Wiss. Wien 85 (1911) 356. — *Stenolobium stans* SEEM. Ann. Mag. Nat. Hist. 10 (1862) 30; J. Bot. 1 (1863) 88, incl. var. *pinnata* SEEM. type var.; BUREAU, Mon. (1864) t. 13; MERR. En. Philip. 3 (1923) 444; STEEN. Thesis (1927) 905; Bull. Jard. Bot. Botz III, 10 (1928) 218.

Shrub, up to c. 1-4 m. Leaflets 1-3 pairs (cult. sometimes 1-foliolate) lanceolate, acuminate, serrate, glabrous, but often along midrib laxly hairy, 3-10 by 1-4 cm, cuneate at the base, no proper petiolules; petiole 2-5 cm. Racemes glabrous, c. 5-15 cm. Pedicels 5-10 mm. Calyx campanulate, 5-7 mm, usually with some impressed plate-shaped glands in middle part or upper half, lobes short-ciliate. Corolla yellow, 3½-5 cm, limb up to 3½ cm Ø. Stamens included, anther-cells ± pilose. Capsule acute, often lenticellate, 10-22 by ½-¾ cm. Seeds (incl. wings) 2 by ½ cm, inserted in two rows on the margins of the septum.

Distr. From Florida through Central and South America to N. Argentina, widely cultivated in the tropics, also in *Malesia*, and sometimes run wild, naturalized e.g. in Tahiti, the Society Is. (Raiatea), and the Marquesas (Nunuhiva), often together with tree ferns and *Gleichenia*.

Notes. Vegetatively a rather variable species. The normal form is with pinnate leaves, but sometimes there are 3-foliolate and even simple leaves intermixed in one sheet. In Tahiti the specimens have 5-6 pairs of leaflets. (This may be var. *multi-jugum* R. E. FRIES, Ark. Bot. 1, 1903, 401). In Mexico a sheet had almost entire leaflets (SUMICHAIST 1885). There is in America a form with

underneath woolly-hairy leaflets: *T. stans* var. *velutina* DC. (*T. mollis* H.B.K.), but the density of the tomentum varies considerably in degree and I am not very much in favour to recognize this; this is also the opinion of STANDLEY (Trees, Shrubs Mexico, 1926, 1319).

JOHNSTON (J. Arn. Arb. 21, 1940, 264) said that in Mexico the normal-leaved form occurs in coastal regions, the incised-leaved form in inland places and the tomentose form south of these two, all three replacing, suggesting subspecific segregation.

It is rather peculiar that, though the normal-leaved form is widely cultivated throughout *Malesia*, the only naturalized one is a fairly constant form with deeply incised leaflets, which seems to be rather rare in the Americas.

var. *incisa* G. DON, Gen. Syst. 4 (1838) 224; J. K. MAHESWARI, Bull. Bot. Surv. India 3 (1961) 357. — *T. incisa* SWEET, Hort. Brit. ed. 1 (1827) 284, nomen. — *T. stans* var. *apiifolium* DC. Prod. 9 (1845) 224; BACK. & BAKH. f. Fl. Java 2 (1965) 539. — *Stenolobium stans* var. *apiifolium* SEEM. J. Bot. 1 (1863) 89; STEEN. Thesis (1927) 906; Bull. Jard. Bot. Botz III, 10 (1928) 218. — ? *Stenolobium incisum* ROSE & STANDLEY, Contr. U.S. Nat. Herb. 16 (1913) 174. — ? *T. stans* var. *angustatum* REHDER, Mitt. Deut. Dendr. Ges. 24 (1915) 227. — *T. incisa* (ROSE & STANDLEY) JOHNSTON, J. Arn. Arb. 21 (1940) 264.

Leaflets (2-3)-(4-5) pairs, very coarsely toothed to deeply pinnately incised, not rarely to the midrib, making acute-triangular lobing, 5-10 by 1-2½ cm (incl. teeth).

Distr. Central America, widely cultivated in the tropics, also in *Malesia*: naturalized in Timor, Ternate, and SW. New Guinea (near Uta); also naturalized in the Concan and N. Kanara (TALBOT).

Ecol. In Timor (Kupang and Baucau Plateau) characteristic for red calcareous soils and limestone, in the latter place gregarious in shrubberies, flowering already at an early age; 5-500 m. Fl. mostly Aug.-Sept. (Oct.), fr. Oct.-Dec.

Vern. Yellow bells, E. Malaya; *ai funan*, Tètulang., E. Timor; *dufa dufa*, Ternate.

6. DEPLANCHEA

VIEILLARD, Bull. Soc. Bot. Normandie 7 (1862) 96; BUREAU, Bull. Soc. Bot. Fr. 9 (1862) 164; BEAUVEUS. Gen. Montrouz. (1901) 90; STEEN. Thesis (1927) 906, f. 8-9;

Bull. Jard. Bot. Btzig III, 10 (1928) 218, f. 2-3; HEINE, Fl. Nouv.-Caléd. 7 (1976) 71, f. 16-17. — *Diplanthera* BANKS & SOL. ex R.BR. Prod. (1810) 448, non THOUARS, 1806, nec SCHRANK, 1819; SCHEFFER, Nat. Tijds. N. I. 31 (1870) 332; B. & H. Gen. Pl. 2 (1876) 1048; STEEN. Nova Guinea 14 (1927) 293. — *Bulweria* F.v.M. Fragm. 4 (1864) 147. — **Fig. 10, 12-13.**

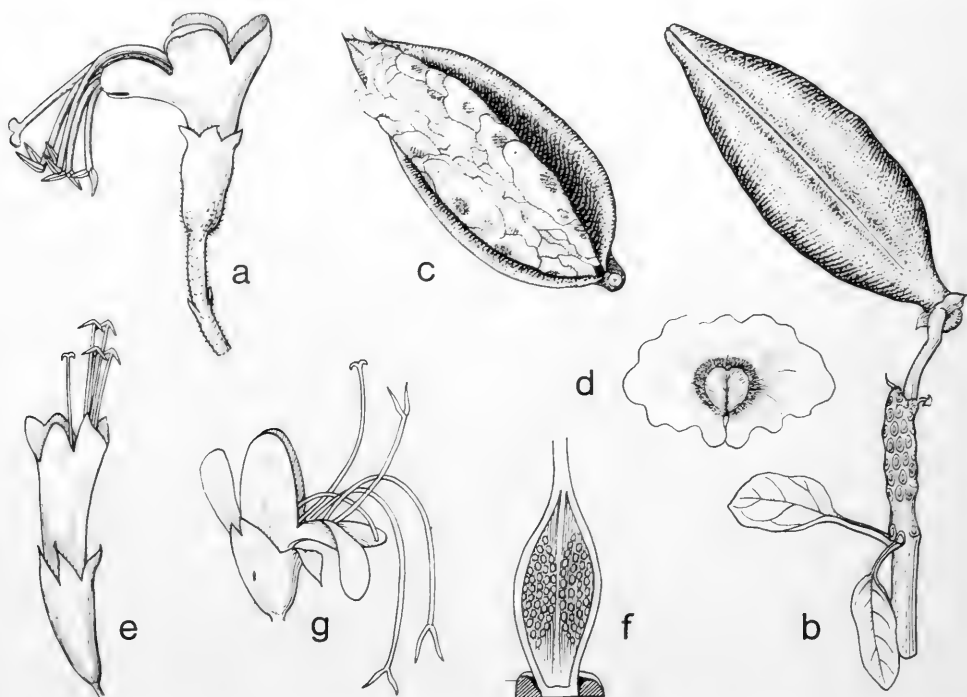


Fig. 10. *Deplanchea bancana* (SCHEFFER) STEEN. a. Flower, b. fruit on thickened rachis, c. opened capsule, seeds covering the septum, d. seed, all nat. size. — *D. glabra* (STEEN.) STEEN. e. Flower, nat. size, f. LS of ovary, enlarged. — *D. tetraphylla* (R.BR.) F.v.M. g. FLOWER, nat. size (a-d C.H.B. XIII-J-65, e-f GJELLERUP 583, g after VAN STEENIS, 1927).

Trees, with thick, pithy branches, robust in all parts. *Leaves* simple, in whorls of 3-4, \pm tufted to end of branches, entire, at base above with a few large crateriform or saucer-shaped glands, underneath often fine-punctiform dotted and sometimes with scattered larger crateriform glands; glabrous or with a yellow indument of simple hairs. *Thyrses* terminal, erect, a thick short rachis with crowded, horizontal, long-stalked triads or twice-forked triads. *Flowers* erect, showy, yellow, stalked. *Calyx* on a 2-3 mm high, obconical, solid hypanthium, articulate with the pedicel, closed in bud, with short lobes hairy at tip, in anthesis with 5 rather regular, acute lobes or tearing into 2-5 unequal, irregular lobes, inside fine-glandular, outside not rarely with few large crateriform glands, tip penicellate. *Corolla* imbricate in bud, lobes ciliate, zygomorphous to degree, hardly with a distinct basal tube, tube just or far exceeding the calyx. *Stamens* 4, didynamous, exserted, rarely a 5th rudiment, \pm erect or recurved to one side, together with a style inserted shortly

above the base of tube, base capitate-glandular hairy; filaments ribbon-shaped; anther-cells free, wide-divergent. Disk annular, crenate. Ovary sessile, glabrous, 2-celled, each cell with 2 closely placed placentas; style very long; stigma with 2 narrow lobes. Ovules ∞ , in many rows. Capsule short-stalked, ellipsoid, with hard, boat-shaped valves, erect; septum flattened, lens-shaped, thick. Seeds very many, roundish, very thin hyaline-winged all around, punctate-inserted.

Distr. Probably 5 spp., 1 in West Malesia, 2 in New Guinea (of which 1 sp. also in N. Australia and the other also in E. Borneo and Central Celebes), and 2 in New Caledonia. Fig. 11.

Ecol. Rain-forests with preference for light and secondary forest, kerangas forest, others in woodland savannahs and invading grasslands, from sea-level to 1000 m.

Notes. The much increased collections gave a better understanding in specific delimitation and variability of characters, leading to reduction in the number of species. Especially the hairiness occurs to degree and is occasionally deviating; in occasional specimens of *D. bancana* the calyx may possess dense long hairs inside the calyx. For this reason I have reduced *D. tubulosa* STEEN. and *D. coriacea* STEEN. The Australian *D. hirsuta* BAILEY I have reduced tentatively to *D. tetraphylla*; I believe it to be a juvenile form which accounts for its sinuate leaf margin and occurrence of deviating phyllotaxis, decussate or whorls of 3.

For brevity's sake the characters mentioned in the key are not repeated in the descriptions.

Specimens in fruit or in bud, or without corolla are difficult to identify.

Affinity. *Deplanchea* has no affinity to other Old World genera. BUREAU (Mon. 1864, 51) compared it with the genus *Delostoma* from Andine South America with which it shares several characteristic features: thick twigs, terminal inflorescences, simple leaves, and boat-shaped fruit valves. *Delostoma* differs in having the valves said to be unequal, one flat, one boat-shaped, and further by triplinerved leaves, a regular, dentate (sometimes 'double') stunted calyx, and pink or violet flowers.

KEY TO THE SPECIES

1. Corolla tubular, the tube \pm twice as long as the calyx, straight or slightly curved. Stamens and style erect, \pm straight in anthesis. Leaves in whorls of 3, underneath almost always very laxly hairy on midrib and nerves as is the petiole. Calyx lobes \pm equal, corolla lobes *ditto* 3. *D. glabra*
1. Corolla tube only for 2–5 mm exceeding the calyx, the limb distinctly zygomorphous, 2 lobes higher connate, patent and longer than the others. Stamens and style patent-curved over this lobe or recurved. Leaves in whorls of 3–4.
2. Branches of the thyrses triads, or flowers solitary. Pedicels $1\frac{1}{4}$ – $2\frac{1}{2}$ cm long. Bud \pm cylindric in shape, rarely pear-shaped, often with 5 faint ribs below the lobes. Calyx with a few to several large crateriform glands, the lobes \pm equal, in anthesis c. $\frac{1}{3}$ – $\frac{1}{4}$ as long as the tube. Corolla tube almost cylindric, c. 10 by 5 mm. Stamens c. 3 – $3\frac{1}{2}$ cm. Leaves in whorls of 3 (by exception 4), hairy underneath or glabrous 1. *D. bancana*
2. Branches of the inflorescence often 2(–3) times forked. Pedicels $\frac{1}{2}$ –2 cm. Buds pear- or spindle-shaped, or obovoid, smooth. Calyx without crateriform glands, distinctly widened \pm campanulate in anthesis, the lobes mostly unequally tearing, sometimes only 2 or 3, $\frac{1}{2}$ – $\frac{2}{3}$ as long as the tube in anthesis. Corolla tube widened almost from the base, c. 1 – $1\frac{1}{4}$ cm high, $1\frac{1}{2}$ cm wide at the mouth in anthesis. Stamens 4 – $4\frac{1}{2}$ cm. Leaves in whorls of (3)–4, always hairy underneath 2. *D. tetraphylla*

1. *Deplanchea bancana* (SCHEFFER) STEEN. Thesis (1927) 921, incl. var. *glabra* STEEN. l.c. 923; Bull. Jard. Bot. Btzig III, 10 (1928) 221, f. 2b, 3. — *Diplanthera bancana* SCHEFFER, Nat. Tijds. N. I. 31 (1870) 334; HASSK. Flora 53 (1870) 219; CLARKE, Fl. Br. Ind. 4 (1884) 385; RIDL. Fl. Mal. Pen. 2 (1923) 552. — *D. coriacea* STEEN. Bull. Jard. Bot. Btzig III, 10 (1928) 224, f. 2c–e. — Fig. 10a–d.

Small to large tree, 4–36 m; bole to 20 m; d.b.h. 15–150 cm, with small or larger buttresses; bark finely fissured, flaky, wood soft, white. Leaves chartaceous to coriaceous, obovate to elliptic, 9–34 by $5\frac{1}{2}$ –20 cm, apex rounded, rarely short-wide-acuminate; base cuneate to cordate; glabrous to yellow hairy in various degree, as is the thyrses; petiole 3–6 cm. Peduncle 5–20 cm; rachis 2–5 cm; primary lateral stalks of triads 2–4 cm. Calyx 12–18 mm. Corolla tube inside at base densely capitate-glandular hairy on insertion of stamens. Anthers

orange, darker than corolla. Fruit 10–14 by $3\frac{1}{2}$ cm. Seeds c. $\frac{3}{4}$ cm \varnothing , incl. wings 3 by 2 cm.

Distr. West Malesia: Sumatra (Palembang, Asahan, Bencoolen, Indragiri, Tapanuli), Riouw Is. (Karimon I., P. Temiang, P. Kedondong), Malaya (also Penang I.), Banka (common), Billiton, and Borneo. Fig. 11.

Ecol. In primary and secondary forests, in Borneo not rare in heath forest, mostly on sandy soils, podzols and wet kerangas, slopes of podzol terraces, from sea-level up to 1000 m. Fl. Jan.–Oct.

Vern. Mëndjanbing, mēngkubēng, mēngkubung, M (Banka), kayu chēndēru, Malacca, labu, Palembang, mēngkubong, mērtapa, P. Temiang, kayu si martim, baha, Batak, tul, M (P. Karimon, in error with *Dolichandrone*?), ēndjabiengien, Billiton.

Notes. A fairly variable plant. In addition to the yellow-tomentose or velutinous haired typical form as described by SCHEFFER there occur glab-

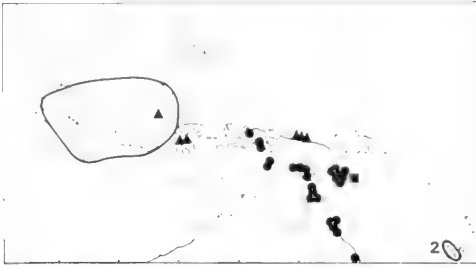


Fig. 11. Range of the genus *Deplanchea* VIEILLARD: *D. tetraphylla* (R.Br.) F.v.M. (dots), *D. glabra* (STEEN.) STEEN. (triangles), *D. bancana* (SCHEFFER) STEEN. (line). In New Caledonia 2 endemic species.

rous forms, but in degree, with few hairs, or the hairs still more reduced and confined to the lower part of the petiolar groove, or only to the axillary bud. There are also specimens of which the calyx is inside long pubescent with 1-seriate hairs, notably S 11989, 16427, 17591, 25411, SAN 32195, ANDERSON 8398, HALLIER B 2507, VAN NIEL 4019, but they are hairy as the type or glabrous, or with small glabrous leaves, rounded leaves or with short acuminate tip. This is also the reason that I cannot maintain *D. coriacea*, as the leaf-base varies from cordate to rounded to cuneate, without correlation with other sets of characters. Also the number of crateriform glands varies and these are also found in other specimens. I will not exclude the possibility that in the field certain biotypes may be bound to certain soil types, but I see no possibility to definitions and formal recognition from the herbarium.

In ANDERSON 8398 from Sarawak the leaves are in a whorl of 4.

Fruits are extremely scarce in the herbarium.

2. *Deplanchea tetraphylla* (R.Br.) F.v.M. Second Syst. Cens. Austr. Pl. 1 (1889) 167; STEEN. Thesis (1927) 916, incl. var. *novoguineensis* STEEN. l.c. 917; Bull. Jard. Bot. Btzg III, 10 (1928) 220; Proc. R. Soc. Queensl. 41 (1929) 55; Webbia 8 (1952) 435. — *Diplanthera tetraphylla* R.Br. Prod. (1810) 449; BTH. Fl. Austr. 4 (1869) 540; SCHEFFER, Nat. Tijds. N. I. 31 (1870) 335; BANKS & SOL. Ill. Cook's Voy. 2 (1901) 72, t. 229; BAILEY, Queensl. Fl. (1901) 1137; Compr. Cat. Q. Pl. (1909) 368; WHITE, Proc. R. Soc. Queensl. 34 (1922) 52; *ibid.* 38 (1927) 259; LANE-POOLE, For. Res. (1925) 137; STEEN. Nova Guinea 14 (1927) 293. — *Bulweria nobilissima* F.v.M. Fragm. 4 (1864) 147. — *D. bulwerii* F.v.M. *ibid.* 5 (1865) 72, (1866) 214. — ? *Diplanthera hirsuta* F. M. BAILEY, Bot. Bull. Dep. Agric. Queensl. 14 (1896) 11; Queensl. Fl. (1901) 1137; Compr. Cat. Q. Pl. (1909) 368. — *Faradaya chrysoclada* K.SCH. & LAUT. Nachtr. Fl. Schutzgeb. (1905) 370; BEER & H. J. LAM, Blumea 2 (1936) 225, cf. LAM & MEEUSE, Blumea 3 (1938) 201. — *D. hirsuta* (F. M. BAILEY) STEEN. Proc. R. Soc. Queensl. 41 (1929) 56. — Fig. 10g, 12-13.

Tree, without buttresses, 4-25 m; d.b.h. 10 to over 100 cm; bole 1-17 m; bark grey or grey-brown, corky, furrowed and rectangular-flaking; wood pale straw-coloured. Leaves chartaceous to coriaceous, usually obovate or oblong-obovate,

underneath yellow-velutinous, base somewhat cuneate to stunted, exceptionally cordate, on the base above with 1-7 cup-shaped large glands, 11-23(-60) by 7-14(-30) cm; petiole $2\frac{1}{2}$ -5 cm. Peduncle 4-12 cm; rachis 3-9 cm; branches 2-7 $\frac{1}{2}$ cm; pedicels 1-2 cm. Calyx 12-14 mm. Fruit 5-11 by c. $2\frac{1}{2}$ cm. Seeds incl. the wings 2 by $1\frac{1}{2}$ cm.

Distr. NE. Queensland (incl. Thursday I., Fitzroy I.) and East Malesia: New Guinea and the Aru Is. (Trangan and Wokam Is.). Fig. 11.

Ecol. Predominantly in the periodically dry belts of New Guinea, also in gallery forest, very rarely in rain-forest, almost confined to grassland and wooded savannahs and associated with *Eucalyptus tereticornis* (Central Distr.) or *Melaleuca*, but also in mixed savannahs (*Antidesma*, *Schefflera*, palms, etc., at Merauke), not rarely common, also a pioneer in fired areas, from sea-level to c. 600 m, rarely at 1200 m (Mafulu). Fl. May-Oct., fr. July-Oct., often flowers and fruits together, but fruiting specimens very rare in the herbarium. Dwarf specimens may in places flower and fruit.

C. J. STEFELS (Verkenningrapport Berari Komebwallier. Mimeo, Fak Fak, 1956, p. 6, 7, 10, phot. 2) reported *D. tetraphylla* from sandy soils, often inundated through an impervious subsoil in a heathy forest of *Melaleuca*.

Field notes: style greenish yellow, filaments yellow, anthers brown. According to VAN ROYEN the flowers have a sourish-sweet scent and are eaten by 'luries', lorikeets (at Merauke).

Uses. At Fak Fak the timber is used for prahus by the Papuans.

Vern. *Laargola*, Trangan, Aru Is., *kapul*, M, Merauke, *bas*, Sorong, Mooi lang., *tembako d'ora*, Fak Fak, Ersania lang., *pwan*, Mumuni, Orokaiva lang., *pakawa*, Maipa, Mekeo lang.

Notes. The phyllotaxis is not constant, several specimens have whorls of 3, reminding of *D. bancana* with which this species is closest related. In 3 m high saplings (DOCTERS VAN LEEUWEN n. 38, cultivated in Hort. Bog. sub XVI.I.F.8) all leaves were opposite.

Similarly saplings in Queensland may have opposite leaves and, moreover, narrow oblong to lanceolate leaves with wavy, even toothed margin (L. S. SMITH 12382). Such plants were described as *D. hirsuta* and may precociously flower; also very small normal-leaved specimens may flower, obviously at an early age, in New Guinea, possibly stimulated by open, pyrogenous habitat. Such specimens may also sucker.

3. *Deplanchea glabra* (STEEN.) STEEN. Thesis (1927) 919, f. 8f, 1; Bull. Jard. Bot. Btzg III, 10 (1928) 225. — *Diplanthera glabra* STEEN. Nova Guinea 14 (1927) 293. — *D. tubulosa* STEEN. Thesis (1927) 926, f. 8g, k, m; Bull. Jard. Bot. Btzg III, 10 (1928) 226. — Fig. 10e-f.

Tree, $1\frac{1}{2}$ -22 m; d.b.h. 12-60 cm; bole 3-12 m; bark grey, scaly; mostly \pm glabrous in all its parts. Leaves obovate-oblong to elliptic-oblong, coriaceous, usually very laxly haired on the midrib (and nerves) below, very rarely yellow short-velutinous on inflorescence, midrib, nerves and petiole, fine dark-dotted beneath, 9-40 by $4\frac{1}{2}$ -25 cm, rarely with some scattered larger glands; base rounded to

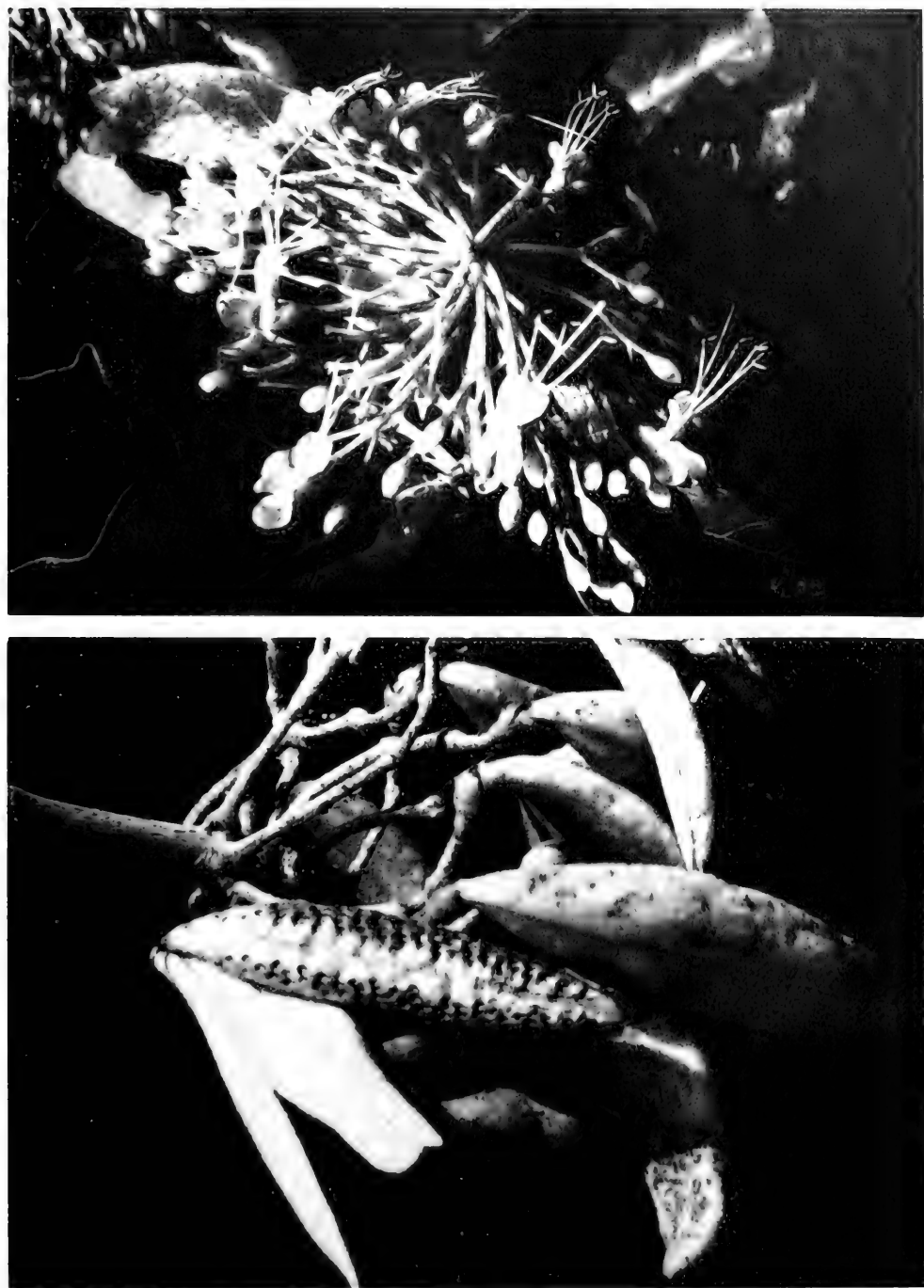


Fig. 12. *Deplanchea tetraphylla* (R.Br.) F.v.M. Inflorescence from above, capsules, partly opened, showing dissepiment (fl. fotogr. HOOGLAND 4249; fr. fotogr. WOMERSLEY, 1956, Sogeri).



Fig. 13. Rather young tree of *Deplanchea tetraphylla* (R.BR.) F.v.M. in Bot. Garden Lae (photogr. M. GALORE).

cuneate or subcordate, apex rounded; petiole $2\frac{1}{2}$ –7 cm. Peduncle 3–7 cm; rachis 1–11 cm; triads $\frac{1}{2}$ –2 cm stalked; pedicels 4–15 mm. Bud spindle-shaped to obovoid. *Calyx* glabrous, very rarely haired on the mid-sepaline ribs, pustular towards apex but the pustules hardly ever opening as crateriform glands, 15–17 mm long, lobes 5 subequal, 3–6 by $2\frac{1}{2}$ –5 mm, c. $2\frac{1}{2}$ – $3\frac{1}{2}$ times as short as the tube. *Corolla* tube inside near the stamens capitate-glandular hairy. Placentas in each cell 2, nearly confluent. *Capsule* 6–9 by c. 2 – $2\frac{1}{2}$ cm. *Seeds* incl. wings $1\frac{1}{2}$ by 1 cm.

Distr. *Malesia* rather common in North New Guinea in the vicinity of Hollandia and Mt Cyclops, also found twice in Central Celebes (Malili, Tobela, Palopo) and once in E. Borneo (Mt Njapa, Kelai R., Berau). Fig. 11.

It is remarkable that the species is obviously never found in other parts of New Guinea.

Ecol. Both in high forest and in savannah, but more commonly in pyrogenous grassland (*Gleichenia-Ischaemum*), as a pioneer, often

flowering and fruiting already when small, 10–700 (–1000) m.

Field notes: pedicels red, filaments and style yellowish green, anthers orange, glands on leaf-base orange. No buttresses. *Fl. fr.* March–Oct.

Vern. Celebes: *momo*, Malili, *kalambutoh*, Toradja.

Notes. Although this species is usually almost glabrous, except for some lax hairs on the midrib beneath, KOSTERMANS & SOEGENG 444, from Hollandia, has very hairy inflorescences, midrib and petioles, so that obviously the indumentum may vary as it does in *D. bancana*.

Also the single Bornean specimen known so far (KOSTERMANS 21491) is similarly hairy; it was found on a mountain ridge at 1000 m alt.

The two specimens from Central Celebes I refer to this species, although one is in fruit and the other in bud, because: the calyx is \pm regularly lobed, with a few pustules but without crateriform glands and the small pod and seed do not match *D. bancana*; both *spp.* have leaves in whorls of 3.

7. DOLICHANDRONE

(FENZL) SEEM. [Ann. Mag. Nat. Hist. III, 10 (1862) 31, *nomen*; J. Bot. 1 (1863) 226, *nomen*] J. Bot. 8 (1870) 379, *nom. cons.*; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 240, f. 92B–D; SPRAGUE, Kew Bull. (1919) 303; STEEN. Thesis (1927) 928; Bull. Jard. Bot. Botz III, 10 (1928) 227. — *Pongelia* RAFIN. Sylv. Tellur. (1838) 78, *nom. rejic.* — *Dolichandra* sect. *Dolichandrone* FENZL, Denkschr. Bay. Bot. Ges. Regensb. 3 (1841) 265. — Fig. 15–16.

Trees with 1-pinnate leaves (or scattered simple leaves, extra-Mal.), leaflets entire (or serrulate, extra-Mal.). *Flowers* in few-flowered terminal racemes, salver-shaped, white, fragrant, nocturnal. *Calyx* not articulate, closed in bud, later spathaceous, caducous. Basal tube of *corolla* long, narrow-cylindric, upper part inflated, lobes mostly crisped. *Stamens* 4, didynamous, 5th rudimentary, inserted at the throat; anther-cells divergent. *Disk* annular. *Ovules* ∞ in 4–6 rows, inserted on 2 placentas in each cell, on the septum. *Capsule* elongate subcylindric to \pm compressed, septum very narrow, false septum very broad and parallel with the valves. *Seeds* hyaline-winged, in the Mal. *sp.* rectangular with thick corky wings.

Distr. *Spp.* 9, one in tropical E. Africa, 4 in tropical SE. Asia, 3 in tropical N. Australia, and one ranging widely from Malabar through Indo-Malesia to New Caledonia. Fig. 14.

Ecol. All inland species, except the wide-ranging *D. spathacea* which is a back-mangrove tree.

Typif. In the Code and in Ind. Gen. *D. spathacea* (L.f.) K.SCH. has been accepted as the type, following SEEMANN (J. Bot. 1, 1863, 226). However, the lectotype must be chosen from the original materials incorporated by FENZL in *Dolichandra* sect. *Dolichandrone*, elevated by SEEMANN to generic rank. He referred to *Spathodea b* of ENDLICHER and *Spathodea* R.Br. Under the first reference *D. spathacea* is not represented, at most a *Dolichandrone* represented by *Bignonia spathacea* (non L.) sens. ROXB. Corom. t. 144, a wrong identification for *D. falcata* (WALL. ex DC.) SEEM. (cf. SPRAGUE, Kew Bull. 1919, 308). This then must be the type of the genus.

Taxon. The Australian species are in habit very different from the African and Indo-Malesian ones: characteristic shrubs or small trees of xerophytic habit and xeromorphous structure, the leaves sometimes obviously not decussate, coriaceous, sometimes entire, with fine parallel ascending veins, or leaflets even needle-like. In addition I find the pods terete and the pseudoseptum not flat, but irregularly, corky swollen with deep impressions of the seeds. According to URBAN (Ber. Deut. Bot. Ges. 34, 1916, 755) these species would also be different in pollen from the other species. I have arranged them in *subg. Coriaceae* STEEN. (Thesis, 1927, 931, f. 10). They should probably be better arranged in a separate section, rather than in a subgenus.

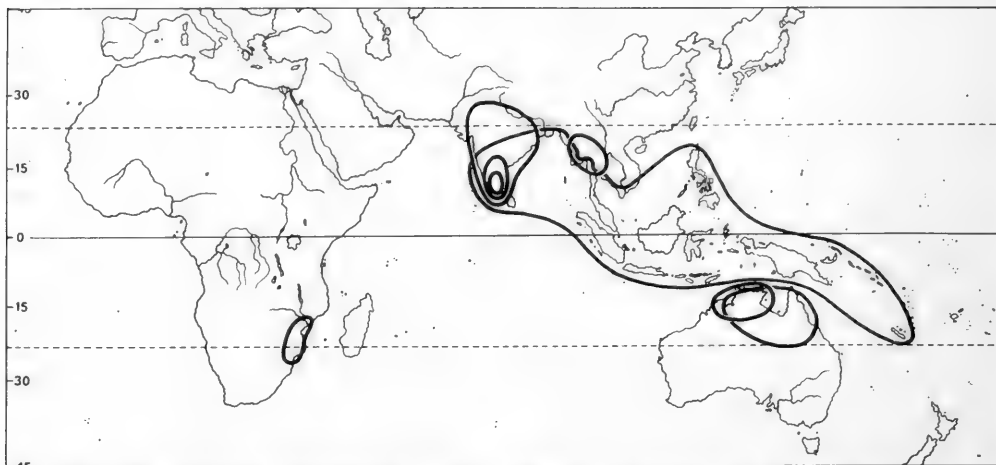


Fig. 14. Range of the genus *Dolichandrone* (FENZL) SEEM. and its species, the largest range being that of *D. spathacea* (L. f.) K.SCH., a mangrove tree with buoyant seeds.

Three *spp.* are distinguished; *D. filiformis* (DC.) F.v.M. is a fairly constant one, with 3–5 filiform leaflets, but *D. heterophylla* (R.Br.) F.v.M. is very variable, with simple to pinnate leaves (3–7 leaflets) also varying in width, whereas *D. alternifolia* (R.Br.) SEEM. with ovate, simple leaflets shows a tendency to split the leaf. Already SEEMANN (J. Bot. 8, 1870, 382) remarked that the latter two probably belong to one variable species, which opinion I now tend to share; he accepted the epithet *heterophylla*.

1. *Dolichandrone spathacea* (L. f.) K.SCH. Fl. Kais. Wilh. Land (1889) 123; MERR. Fl. Manila (1912) 429; Int. Herb. Amb. (1917) 469; Sp. Blanc. (1918) 349; SPRAGUE, Kew Bull. (1919) 304; STEEN. Thesis (1927) 937; Bull. Jard. Bot. Btzig III, 10 (1928) 227; C. T. WHITE, J. Arn. Arb. 10 (1929) 265; MERR. Comm. Lour. (1935) 355; CORNER, Ways. Trees (1940) 163, Atlas pl. 26–27; HEINE, Fl. Nouv.-Caléd. 7 (1976) 81, pl. 18. — *Niir Pongelion* RHEEDE, Hort. Mal. 6 (1686) 53, t. 29. — *Lignum equinum* RUMPH. Herb. Amb. 3 (1750) 73, t. 46. — *Bignonia spathacea* L. f. Suppl. (1781) 283; RETZ. Obs. Bot. 5 (1788) 5; BLANCO, Fl. Filip. (1837) 499. — *Bignonia longissima* LOUR. Fl. Coch. (1790) 380, *nom. illeg., non* JACQ. 1760. — *Bignonia javanica* THUNB. Mus. Nat. Ac. Upps. 17 (1794) 150, *nomen*; Fl. Ceil. (1825) 7, *nomen*, cf. STEEN. Blumea 6 (1950) 359. — *Spathodea longiflora* VENT. Choix (1803) 40; SPAN. Linnaea 15 (1841) 326. — *Spathodea rheedii* SPRENG. Syst. 2 (1825) 835, *quoad syn.*; WALL. Cat. (1832) n. 6516; DC. Prod. 9 (1845) 206; MIQ. Fl. Ind. Bat. 2 (1858) 754. — *Pongelia longiflora* RAFIN. Sylv. Tellur. (1838) 79. — *Bignonia longiflora* WILLD. ex DC. Prod. 9 (1845) 206. — *Spathodea loureiriana* DC. l.c. 209. — *Spathodea luzonica* BLANCO, Fl. Filip. ed. 2 (1845) 350; ed. 3, 2 (1878) 284, t. 242. — *Spathodea diepenhorstii* MIQ. Fl. Ind. Bat. 2 (1858) 754. — *D. rheedii* SEEM. J. Bot. 8 (1870) 380; KURZ, Fl. Burma 2 (1877) 234; CLARKE, Fl. Br. Ind. 4 (1884) 379; K. & V. Bijdr. (1894) 69; GAMBLE, J. As. Soc. Beng. 74, ii (1905) 377; RIDL. Fl. Mal. Pen. 2 (1923) 549. — *D. longissima* K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 240. — Fig. 15–16. For fuller references see STEEN. (1928).

Evergreen, glabrous tree, 5–20 m; 10–40 cm \varnothing ; wood soft, white. *Leaves* usually 3–4-jugate, 15–35 cm, stalked, in the herbarium nigrescent as all other parts; young parts \pm viscid, young leaves slightly pinkish in the field (CORNER); leaflets thin, ovate-oblong to lanceolate, unequal-sided, entire, long-tipped (in seedlings sometimes toothed), 6–16 by 3–7 cm, underneath with hairy domatia. *Racemes* 2–8-flowered. *Rachis* 2–3 cm. *Bracts* caducous. *Bracteoles* 0. *Pedicels* 2–4 cm. *Flowers* not articulated. *Calyx* conical, coriaceous, usually arcuate, beaked, circumscissile caducous, with many microscopical glands and a field with large crateriform glands at apex, 3–6 (–8½) cm. *Corolla* tube 12–18 cm long, the mouth 7–12 cm \varnothing ; basal tube 9–12 cm, gradually funnel-shaped expanded above the throat for 4 cm; lobes 5, broad, subequal, frilled round the edge, with large glands, 2½–3 cm. *Stamens* not exerted. *Style* exerted. *Capsule* flattened-cylindrical, \pm ribbed, straight or \pm arcuate, or twisted, tipped, 25–70 by 2–3 cm; valves hard leathery, pseudoseptum flattish, hard corky, c. 1½–1¾ cm wide. *Seeds* dark grey, rectangular, in many rows, 12–18 by 6–8 mm including the thick corky wings; attachment a fine line, 8–10 mm long.

Distr. From the coast of Malabar throughout tropical SE. Asia and the whole of *Malesia* to New Guinea, Micronesia (W. Carolines: Korrör; Yap: Tomil I.), the Solomons, the New Hebrides and New Caledonia, not found in Australia and Polynesia. Fig. 14.

Ecol. Confined to the back-mangrove and banks of tidal rivers and estuaries. RIDLEY (Kew Bull. 1910, 203; J. As. Soc. Str. Br. 59, 1911, 40, 146)

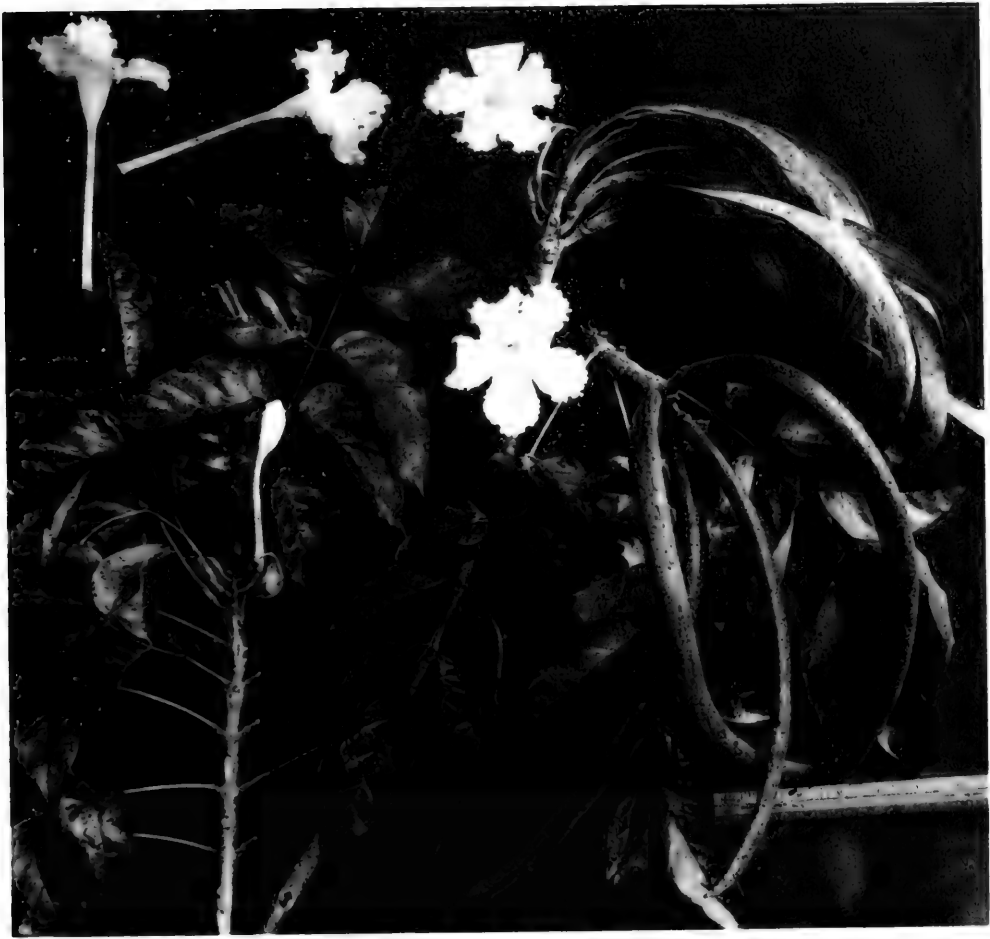


Fig. 15. *Dolichandrone spathacea* (L. f.) K.Sch. Flowers and twigs in bud and fruit, magnification $\frac{1}{5}$; upper capsules opened (photogr. CORNER).

recorded it common in low-lying rice-fields near Kanga village, Lower Siam, as the predominant tree, which he ascribed as "relics of the time when this whole country was a tidal swamp, gradually filled up after the disappearance of the sea". Other seashore plants were also found in these paddy fields, such as *Euphorbia atoto*. This inland occurrence is also stressed by CORNER (*l.c.* 164) who found it "frequently in coastal rice-fields; in Perlis it is indeed a feature of the country; also in North Kedah, as soon as one reaches Kodiang it attracts attention, standing in the paddies as an upright poplar and flanks the roads which lead to Kangar and Singgora. Old tree trunks are massive and fluted at the base, the crown tapering upward. The old, opened twisted pods remain for a long time on the tree."

BRASS found it very abundant in Daru I. (S. New Guinea), while K. J. WHITE found almost pure stands in Umboi I. (Morobe Distr.) in swamps behind the mangrove. He recorded it also from freshwater swamps in the Markham Valley. At the Bogor Botanic Gardens it is successfully cultivated in freshwater.

The calyx is filled with water in bud. The very young inflorescence and developed ovary is often slightly glossy varnished in the herbarium, similarly as is found in *Radermachera*, certainly by the exudate of glands which are found at the apex of the calyx. *Fl. fr.* Jan.-Dec., flowers and fruits not rarely found together. KOORDERS (1894 *l.c.*) and HEYNE (Nutt. Pl. 1371) say that in the dry season it may be at times nearly leafless fruiting in Central and East Java.



Fig. 16. Trees of *Dolichandrone spathacea* (L. f.) K.SCH. in the coastal rice-fields of Perlis where it is a feature of the country (photogr. CORNER).

Pollination. Flowers open at dusk and drop before sunrise; they must be pollinated by hawk-moths with very long tongues to attain the honey. In each inflorescence one flower is open at a time (CORNER).

Dispersal. The corky seeds float readily and must be dispersed by seawater. In this respect it is strange that the species is not found in northern Australia and Polynesia.

Uses. Of little use other than fire-wood; in N. Borneo a collector deemed the wood useful for making clogs and matches; in the Carolines (Koror I.) leaves and fruit are said to be used as a substitute for betel leaves in chewing. HEYNE (Nutt. Pl. 1371) said that the wood is not durable, but light and easy to work for small things in the house; pieces of branches are sometimes used for floats of fishing nets in East Java and the Karimon Djawa Is.; in the Minahassa it is used for scabbards, in Madura I. for masks for the *topèng*. In Madura a cold concoction of the leaves is also used against mouth sprew. RUMPHIUS said that in Ambon twigs of *lignum equinum* (translation of *kaju kuda*) were used for making hedges.

Vern. Malaya: *poko kulo*, *tuj*, M; Sumatra: *tuwè-èj*, Atjeh, *kudo-kudo uwi*, Simalur, *kuda kuda*, Pariaman, *ki arak*, Palembang; Java: *kaju* or *ki djaran*, M, *djarang*, S, *djaram*, *djaran pèlok*, *djaranan*, *kadjèng kapal*, *kaju pèlok*, *kapal*, J, *kadju djaran*, *kaju djaran binèk*, Md; Borneo: *kèlaju*, *tuwi*, Kutai, *toi*, *tui*, Brunei, Bajau lang., *towi*, Kedayan; Celebes: *fojet*, *kaju pèlumping*, *sangi*, *tomana*, Minahassa; Talaud Is.: *sansarangi*; Alor: *bombila*; Ternate: *djodjamé*; Tidore: *djamé*; Ambon: *kaju kuda*, *kati kati*; Philip.: *tua*, *tui*, Tag., *pata*, Ilk., *taṅgas*, Tagb., *tanhas*, C. Bis., *tanghas*, P.Bis., *tewi*, Mbo., *tiwi*, Tag., Bik., C.Bis.; New Guinea: *tie*, Holtekang, Wembie lang., *pide*, *pier*, S. New Guinea, Asmat lang., *aisumbu*, Mani-kiang lang., *asember tiy*, Oransbari, Hatam lang., *dau*, Cape Vogel, Wanigela; New Britain: *latiu*, W. Nakanai, *tavituviti*, Gazelle Pen., Boava lang.; Solomons: *kwae kwaele*, Guadalcanal, *kwe kweale*, Malaita, *kwe'ekwe'eali*, Kolombangara, *ririge*, Small Nggela, Kwara'ae lang.

Note. Especially leaflets of saplings may, at times, show some serrulations on the margin and may also be slightly hairy.

8. STEREOSPERMUM

CHAM. *Linnaea* 7 (1832) 720; A.DC. *Prod.* 9 (1845) 210; B. & H. *Gen. Pl.* 2 (1875) 104, *pro sect. Eustereospermum*; STEEN. *Thesis* (1927) 946; Bull. *Jard. Bot. Btzig* III, 10 (1928) 233; CHATTERJEE, *Bull. Bot. Soc. Beng.* 2 (1948) 68. — *Hieranthes* RAFIN. *Sylv. Tellur.* (1838) 79. — *Dipterosperma* HASSK. *Flora* 25, 2 (1842) Beibl. 1, p. 28; *Cat. Hort. Bog.* (1844) 152; *Pl. Jav. Rar.* (1848) 507. — Fig. 17, 19.



Fig. 17. *Stereospermum personatum* (HASSK.) CHATTERJEE. a. Habit, b. capsule, both $\times \frac{1}{2}$, c. seed, nat. size (a after WIGHT, *lc.* 4, t. 1341, b-c BEUSEKOM & GEESINK 3662).

Rather tall, deciduous trees. *Leaves* 1-pinnate; leaflets a few pairs, diminishing in size downwards, underneath usually with flat, dish- or cup-shaped glands or glandular spots; no domatia (in Mal.). *Thyrses* well-branched, paniculiform, mostly terminal, or on old wood. *Flowers* fragrant (in Mal.). *Calyx* usually short-lobed. *Corolla* infundibuliform; basal tube mostly concealed in the calyx, upper part usually funnel-shaped; mouth bilabiate, upper lip 2-, lower 3-cleft, lobes subequal, rounded, crisped, toothed or lacinate. *Stamens* 4, didynamous, included, 5th rudimentary; anthers glabrous, cells divergent. *Disk* cupular to annular. *Ovary* cells each with 2 rows of many ovules. *Capsule* long linear, terete, mostly twisted, usually 4-angular in section; septum thick, corky, terete, with alternating notches to fit the thick seeds which appear in two rows; valves coriaceous. *Seeds* ∞, thick, trigonous, wedge-shaped, with a cross-groove, on both sides thinly winged; cotyledons folded, 2-lobed, radicle straight.

Distr. Over a dozen *spp.*, in tropical Africa and Madagascar, in SE. Asia as far east as Yunnan, in *Malesia*: 2 *spp.* in Malaya, possibly also in Sumatra, and a doubtfully indigenous record of a third in East Java. Fig. 18.

Ecol. Largely confined to regions subject to a seasonal climate, all in the lowlands, in everwet rain-forest obviously deciduous and flowering after a dry spell.

Note. Besides the 3 Malesian *spp.* distinguished here, P. DOP mentioned *S. cylindricum* PIERRE from Malaya (Fl. Gén. I.-C. 4, 1930, 582), but this must rest on an error as that species is only known from Thailand and Indo-China (cf. SANTISUK, Thai For. Bull. Bot. 8, 1974, 22).

KEY TO THE SPECIES

1. Inflorescence (incl. flowers) viscid-hairy by patent capitate-glandular hairs. Leaves not glabrous. Corolla tube gradually funnel-shaped widened, straight, Stamens glabrous at base. Capsule not 4-ridged.
2. Leaflets 0–5 mm stalked, base cuneate-attenuate. Capsule faintly 3-ridged on each valve, c. 15–18 mm Ø, septum 8–13 mm Ø. Calyx campanulate, 5–7 mm. Corolla dull purple, yellow-streaked within, c. 3 cm (stretched); lobes crenulate; tube c. 1³/₄ cm. Filaments towards the insertion with small granular glands 2. *S. chelonoides*
2. Leaflets 5–11 mm stalked, rounded to subcordate at the base. Capsule only with 1 median ridge on each valve, 8–12 mm Ø, septum 6–9 mm Ø. Calyx ± cylindric, 8–12 mm. Corolla pale lilac, 6–7 cm; lobes deeply fringed-lacinate; tube c. 4 cm. Filaments glabrous 1. *S. fimbriatum*
1. Inflorescence and leaves glabrous (or very rarely minutely puberulous). Corolla c. 3 cm, suddenly widened and curved above the basal tube, yellowish, the limb with reddish veins and markings, lobes crenulate. Throat and base of filaments densely hairy. Leaflets 5–15 mm stalked, long-acuminate. Calyx campanulate, 4–5 mm. Capsule 4-ridged, 8–10 mm Ø; septum 4–5 mm Ø 3. *S. personatum*

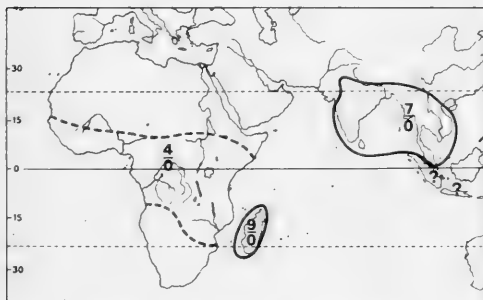


Fig. 18. Range of the genus *Stereospermum* CHAM. In Asia and Africa generalized, and numbers of species an approximation. Occurrence in Sumatra and Java doubtful.

1. *Stereospermum fimbriatum* (WALL. ex G. DON) A.DC. Prod. 9 (1845) 211; KURZ, Fl. Burma 2 (1877) 231; CLARKE, Fl. Br. Ind. 4 (1884) 383; GAMBLE, Man. (1902) 516; J. As. Soc. Beng. 74, ii (1905) 378; RIDL, Fl. Mal. Pen. 2 (1923) 550; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 234; DOP, Fl. Gén. I.-C. 4 (1930) 578; CORNER, Ways. Trees (1940) 172, pl. 33; CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 69; SANTISUK, Thai For. Bull. Bot. 8 (1974) 23. — *Bignonia fimbriata* WALL. [Cat. (1832) n. 6500, *nomen*] ex G. DON, Gen. Syst. 4 (1838) 221. — Fig. 19.

Very upright, deciduous tree, to 27–30 m by 30–160 cm Ø; crown narrow, cylindrical, rather open; bark light grey, rough and flaky; young leaves purple or violaceous. *Leaves* 30–75 cm, with rather sticky hairs, stalks yellowish; leaflets (2–)3(–4) pairs, rounded at the asymmetric base, ovate-oblong, long-tipped, 8–16 by 3–7 cm;



Fig. 19. *Stereospermum fimbriatum* (G. DON) A. DC. Its slender habit; some trees deciduous; on the churchyard in Malacca (photogr. CORNER).

petiolules 5–10 mm. Flowers in large spreading viscid-pilose clusters, 8–30 cm \varnothing , on the bare twigs or with the new leaves. Calyx tubular, with 5 very short pointed lobes, c. 8–12 mm. Corolla dull white to pale pink or pale pinkish lilac, narrow funnel-shaped, without a distinct basal tube, the tube 4–5 cm long, the lobes beautifully long-fringed (as a dainty night cap), c. 2 cm. Filaments glabrous, inserted at c. 11–13 mm from the base. Capsule more or less quadrangular, snake-like twisted, 35–60 cm by 8–12 mm; septum c. 5 mm \varnothing . Seeds

c. $2\frac{1}{2}$ cm long, 7 mm wide, with rather thick wings.

Distr. Continental SE. Asia (Burma; Thailand: Chiangmai to Peninsular Thailand); in Malesia: Malay Peninsula (incl. Langkawi, Penang, and Tioman Is.), possibly also in Sumatra.

The record from Sumatra rests on an unpublished, beautiful plate in a collection of RAFFLES in the India Office Library & Records (NHD 49/20), which might have been made in Bencoolen, but according to Mr R. DESMOND the provenance is uncertain. It might be rare in Sumatra, similarly as *S. personatum*.

Ecol. In the lowland and hill forests, in Burma up to 1000 m, in Malaya in high forest and open country: frequent in villages and belukar from Malacca to Perlis and Kelantan, often on rocky coasts and headlands. Fl. Febr.–June, fr. March–Nov. “After the first spell of dry weather the leaves are shed and the flowers appear on the bare boughs in delicate clusters until the new foliage is mature; in the early morning the corollas spin down like snow-flakes and carpet the ground with pale lilac blossom. There are many trees in the Christian Cemetery at Malacca, and a fairer one for a graveyard would be hard to come by” (CORNER, l.c.).

Uses. A hard and durable fairly large timber rather dark coloured, used for beams and posts and said to be durable in the soil.

Roots and leaves are used medicinally for some minor ailments: juice of leaves is dropped into the ear for ear-ache; leaves pounded with lime are applied to the skin for itch; a decoction of roots is given as a protective medicine after childbirth (BURKILL, Dict. 1935, 2082).

Vern. Malaya: *chac(h)a(h)*, *chachar*, *chechar*, *chicha(r)*, *M*, *lempoyan*, *beka(k)* (BURKILL), *snake tree*, *E* (CORNER).

2. *Stereospermum chelonoides* (L. f.) A.P.DC. Bibl. Univ. Genève II, 17 (1838) 125, *pro comb.*, *excl. ref.* RHEEDE t. 26; A.DC. Prod. 9 (1845) 210, *pro basion.*; HAINES, Kew Bull. (1922) 121, *in text*; SANTISUK, Kew Bull. 28 (1973) 176; *non auct. al.* — *Bignonia chelonoides* L. f. Suppl. (1781) 282, *pro typ.*, *excl. ref.* RHEEDE; *non auct. al.* — *Bignonia suaveolens* ROXB. Fl. Ind. ed. Carey 3 (1832) 104. — *Tecoma suaveolens* G. DON, Gen. Syst. 4 (1838) 224. — *Hieranthes fragrans* RAFIN. Sylv. Tellur. (1838) 79, *nom. illeg.* — *S. suaveolens* A.DC. Prod. 9 (1845) 211; WIGHT, Ic. 4 (1848) 9, t. 1342; KURZ, Fl. Burma 2 (1877) 231; CLARKE, Fl. Br. Ind. 4 (1884) 382; TRIMEN, Fl. Ceyl. 3 (1895) 284; GAMBLE, Man. (1902) 515; BRANDIS, Ind. Trees (1906) 495; HAINES, Fl. Bihar Orissa (1922) 656; BEUMÉE, Fl. Anal. Onderz. (1922) 33; GAMBLE, Fl. Madras 2 (1924) 998; STEEN, Thesis (1927) 948, *incl. f. verticillatum* STEEN. l.c. 950; Bull. Jard. Bot. Btzg III, 10 (1928) 236; DOP, Fl. Gén. I.-C. 4 (1930) 588; CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 70; BACK. & BAKH. f. Fl. Java 2 (1965) 540.

Deciduous tree, up to 30 m, 80 cm \varnothing ; timber dark, hard. Innovations viscid hairy. Leaves opposite (rarely in whorls of 3), 30–50 by 15–25 cm; leaflets 3–4 pairs, viscid-hirsute, glabrescent, rough above and brittle when mature, ovate to obovate to broadly oblong, acute to short-acuminate, entire or fine-dentate, 5–23 by 3–10 cm; glandless or with a few scattered spots; midrib finally puberulous

above, venation sparsely hirsute beneath; petiolules thick, 2–3(–5) cm. *Thyrse* up to 25 cm \varnothing , viscid-pubescent with capitate-glandular hairs. *Flowers* dull crimson to dull purple, yellow streaked within, very fragrant. *Calyx* campanulate, viscid pubescent, 6–8 mm, shortly acutely 5-lobed. *Corolla* viscid-hairy, 2 $\frac{1}{4}$ –3 cm long, the tube rather gradually funnel-shaped, mouth long pubescent; lobes subentire, \pm as long as the tube. *Filaments* inserted at 4–5 mm from the base, towards the insertion with small sessile granular glands. *Ovary* 4-ribbed, sometimes sparsely glandular. *Capsule* smooth or valves obscurely 3-ribbed, to 45 by 1 $\frac{1}{2}$ –1 $\frac{3}{4}$ cm; valves woody; septum 8–13 mm \varnothing . *Seeds* 3 $\frac{1}{2}$ by $\frac{3}{4}$ cm.

Distr. Widely distributed in continental tropical SE. Asia, from Ceylon and the Deccan to Assam and Burma, not yet reported for Thailand and erroneously so for Indo-China (SANTISUK, *l.c.*); in *Malesia*: very locally found in East Java, but somewhat doubtful whether native.

BEUMÉE *l.c.* recorded this tree for the first time for East Java, where it was found locally in some places in the (teak) forest districts S. Surabaya and E. Tuban. He suggested that this occurrence would fit the theory of a number of forest officers of early import by Hindus of teak and some associated trees (*Butea monosperma*, *Schleichera oleosa*, etc.) and several other plants. I certainly agree that in the Hindu period (roughly 800–1400 A.D.) plants have come from India, especially those favoured for sacred purposes; for example *Cochlospermum religiosum* (L.) ALSTON, and others went to India *vice versa*, as for example *Santalum album* L. (see C. E. C. FISCHER, *J. Bomb. Nat. Hist. Soc.* 40, 1938, 458–467). The first is still only found near Hindu temples in Bali and the latter is still spreading in India. The disjunction between the localities in East Java and India-Burma is in these cases certainly caused by intentional dispersal by man in historic time.

There are, however, a large number of other plants showing this same disjunction, and all bound to a seasonal climate, that is, subject to a distinct annual period of drought. In a succinct analysis I found these to belong to 4 classes (Hand. 8th Ned. Ind. Natuurwet. Congr. Surabaya 1938, 1939, 408–409). Later I have further elaborated this problem and tried to solve it (Reinwardtia 5, 1961, 420–429, maps 1–6). From this it appeared that the ecological disjunction of the seasonal climate between the colossal area it covers in SE. Asia (south as far as Tenasserim) and a similar ecology in Central & East Java and the Lesser Sunda Is. is shared by a homologous plant-geographical disjunction of many hundreds of plants which do not occur in everwet West Malesia, or only in very local seasonal spots in Celebes and the Philippine Islands. A fair number extend their range south-eastwards to Australia. This proves that such patterns are quite natural; I have assumed they originated during the Pleistocene Glacial Period, which created a temporary pathway for drought plants between SE. Asia and Australia, to vanish in the Late Holocene.

It could thus well be that also *S. chelonoides* does occur in the native state in the East Javanese teak forest. As a matter of fact no fruit has yet been collected, although flowering was abundant. I

cannot subscribe to the opinion of BEUMÉE that its dispersal is here by vegetative means, because I cannot well see by what vegetative means and furthermore because it is difficult to see how it would have maintained itself vegetatively in this way for many centuries. On the other hand the existence of a Javanese vernacular name is no argument that it is native; experience tells us that such names are often invented quickly. If it is native, it remains curious that, though it is obviously of rare occurrence, it was only recently discovered. It cannot be disproved, however, that its seed was inadvertently introduced by the Forest Service with teak seed from India or Burma.

Ecol. Seasonal forest and savannahs. *Fl.* Sept.–Oct. (India: April–June), *fr.* (Asia) Nov.–Dec.

Uses. GAMBLE, *l.c.* 516, said it is in SE. Asia rather an important large tree by its durable timber which is easy to work and good for building, though the amount of heartwood is small. It also is an excellent fire-wood and makes good charcoal. The root and bark are used as a favourite tonic native medicine. It also is important in silviculture for its very free seed reproduction; the fruit remains long unopened on the tree and seed gets dispersed at the very end of the hot season after the danger of fire is nearly over, and can germinate with the first rains. Even on exposed slopes and among grass its good natural reproduction is noticeable.

BURKILL (Dict. 1935, 2082) mentions that it yields a gum of the tragacanth class. He also mentioned that it is referred to as a plant of magic in Sanskrit India, *patala*, being the Sanskrit name, of which modern vernaculars have been derived. In this respect it is noteworthy that the Javanese name 'bedali' is a name for *Radermachera* spp. TRIMEN reported it in Ceylon planted near Buddhist temples.

Vern. *Djati tēkēn*, *kaju tēkēn*, J.

Notes. In East Java one specimen had leaves in whorls of three. Leaves of saplings and suckers may show a serrate-dentate leaf margin. Such leaves are sometimes also rather narrow and acuminate; those of mature trees are broader and more wide at apex.

Under *S. personatum* I referred to the lamentable name change caused by erroneous interpretation of the type of *Bignonia chelonoides* L. f. The first to observe this was G. DON, *l.c.*, who put '*B. chelonoides* Kon.' under the synonyms of *Tecoma suaveolens*. Then HAINES remarked that the type of *Bignonia chelonoides* L. f. was currently named *S. chelonoides* (Kew Bull. 1922, 121). I myself (Thesis, 1927, 951) was of the same opinion. But these observations were not evaluated nomenclaturally until recently by CHATTERJEE and SANTISUK.

3. *Stereospermum personatum* (HASSK.) CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 70; SANTISUK, Kew Bull. 28 (1973) 178; Thai For. Bull. Bot. 8 (1974) 26. — *Padri* RHEEDE, Hort. Mal. 6 (1736) 47, t. 26. — *Bignonia chelonoides* (non L. f.) ROXB. Fl. Ind. ed. Carey 3 (1832) 106, p.p. — *S. chelonoides* [non (L. f.) A.P.DC.] A.P.DC. Bibl. Univ. Genève II, 17 (1838) 125, *quoad ref.* RHEEDE, t. 26; A.DC. Prod. 9 (1845) 210, p.p.; KURZ, Fl. Burma 2 (1877) 230; CLARKE, Fl. Br. Ind. 4 (1884) 382; TRIMEN, Fl. Ceyl. 3 (1895) 283; RIDL, Fl. Mal. Pen. 2 (1923)

550; STEEN. Thesis (1927) 951; Bull. Jard. Bot. Btzig III, 10 (1928) 237; DOP. Fl. Gén. I.-C. 4 (1930) 579; CORNER, Ways. Trees (1940) 172, f. 43. — *Dipterosperma personatum* HASSK. Flora 25, 2 (1842) Beibl. 1, p. 28; Cat. Hort. Bog. (1844) 152; Pl. Jav. Rar. (1848) 507. — *S. tetragonum* A.DC. Prod. 9 (1845) 210; HAINES, Fl. Bihar Orissa (1922) 655; Kew Bull. (1922) 121; GAMBLE, Fl. Madras 2 (1924) 998; HAND.-MAZZ. Symb. Sin. 7 (1936) 889. — *Bignonia caudata* A.DC. Prod. 9 (1845) 166. — *S. hasskarlii* Z. & M. ex ZOLL. Syst. Verz. 3 (1855) 54, *nom. illeg.*, based on *Dipterosperma personatum* HASSK.; MIQ. Fl. Ind. Bat. 2 (1858) 756; Ann. Mus. Lugd. Bat. 1 (1864) 200. — *S. caudatum* MIQ. l.c. 200. — Fig. 17.

Deciduous, glabrous tree, up to 30 m, 75 cm \varnothing ; bark pale pinkish grey becoming rather coarsely fissured and flaky but not ridged. Young leaves purplish or pinkish (CORNER). *Leaves* glabrous, 20–50 cm; leaflets 3–6 pairs, elliptic-oblong, gradually tapering to the base, tip acuminate to caudate; 5–15 by 2½–6 cm; underneath minutely glandular-punctate, often with a few large flat spot-glands (black in dry state); petiolules slender, 5–15 mm. *Thyrses* widely branched, paniculiform, to 40 cm long. *Flowers* dingy yellow, cream within with dark red stripes, in slender, erect, lengthening thyrses 15–40 cm long, on the bare twigs with the new leaves, c. 3 cm long, 1¾ cm wide at the limb. *Calyx* campanulate, 6–8 mm, with 3–4 short acute lobes, purple. *Corolla* with a narrow basal tube 4–5 mm long, then campanulately widened and curved, the bell-shaped part compressed with the mouth closed and the underside grooved; tube c. 1¾ cm long; lobes crisped, the upper two recurved, the lower bearded at the mouth, ochre-buff with brownish or purplish lines, pinkish purple on the outside (CORNER). *Filaments* with a dense hair tuft at the base. *Capsule* linear, \pm terete, 4-ribbed, curved or twisted, 8–45 cm by 8–10 mm; septum 4–5 mm \varnothing . *Seeds* 2 by ½ cm, incl. wings ¾ cm.

Distr. Widely distributed from Ceylon through entire continental tropical SE. Asia to Yunnan and Indo-China; in *Malaysia*: Malaya (very rare, only in Penang, e.g. on Glugor Road, and Singapore), possibly also in Sumatra.

Unfortunately there is no certainty about the records in Indonesia: HASSKARL described his type from trees cultivated in the Botanic Gardens at Bogor; ZOLLINGER described *S. hasskarlii* also from a cultivated tree in these gardens (ZOLLINGER

3069) but noted that it would have originated from Bantam, West Java, adding the Sundanese vernacular '*ki langir*'; a duplicate of this number in Paris is said by SANTISUK to have been annotated to come from the Lampong Distr. in S. Sumatra, which then probably is an error.

Then there is a collection said to have been collected by KORTHALS with 'Borneo' printed labels. This provenance is very unlikely, as the use of these old labels has been proved to be often erratic. These specimens may have come from West Central Sumatra but may also have been collected by KORTHALS in the Bogor Botanic Gardens. Plant-geographically the species might occur (or have occurred) in Sumatra and West Java, but probably as rare as in Malaya because of its preference for seasonal forest conditions.

Ecol. Preferring lowland forests, up to 1000 m. *Fl.* March–July (at Bogor Aug., Nov.–Febr.), *fr.* Febr. (Asia), June (Malaya).

Uses. According to BURKILL in India an important timber tree, especially in the northeast where it is common; the hard grey wood is moderately durable and easy to work, good for furniture, used but less good for building; in Assam and E. Bengal *padri*-wood is used for canoes and tea-boxes. In S. India a cooling drink, from roots and flowers, is given in fevers. The fragrant flowers are offered in temples.

Nomencl. There has been a most unfortunate confusion about the identity of *Bignonia chelonoides* L. f. (1781). This emanated from LINNÉ f. who described it as a hairy plant (type herb. König, in LINN), but added the reference to *Padri* of RHEEDE, an other glabrous species with long petiolules. This probably misled ROXBURGH who applied LINNÉ's epithet to the latter. This interpretation was followed by almost all subsequent authors. In 1922 HAINES concluded that two species were involved and he adopted for the present one the name *S. tetragonum* DC. In 1948 CHATTERJEE replaced this by an older epithet of HASSKARL.

Notes. As in several other members of this family leaves from suckers and saplings may be toothed or serrate at the margin; leaves of mature trees are entire.

In a few continental Asiatic specimens a very minute puberulous indument occurs on nerves underneath in the inflorescence (KERR 1167, KOSTERMANS 1056, LESCHENAULT 157).

9. RADERMACHERA

ZOLL. & MOR. in Zoll. Syst. Verz. 3 (1855) 53; BUREAU, Adansonia 2 (1861) 192, t. 2; Mon. (1864) 50, t. 28; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 250; SEEM. J. Bot. 8 (1870) 145; JACKSON, Ind. Kew. 2 (1895) 679 ('*Radermachia*'); STEEN. Thesis (1927) 953; Bull. Jard. Bot. Btzig III, 10 (1928) 238; DOP, Fl. Gén. I.-C. 4 (1930) 583; CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 71; SANTISUK, Thai For. Bull. Bot. 8 (1974) 27; STEEN. Blumea 23 (1976) 121. — *Lagaropyxis* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 198. — *Mayodendron* KURZ, Prel. Rep. For. Veget. Pegu, App. D (1875) pl. 1 & 2; Fl. Burma 2 (1877) 232. — *Stereospermum* sect.

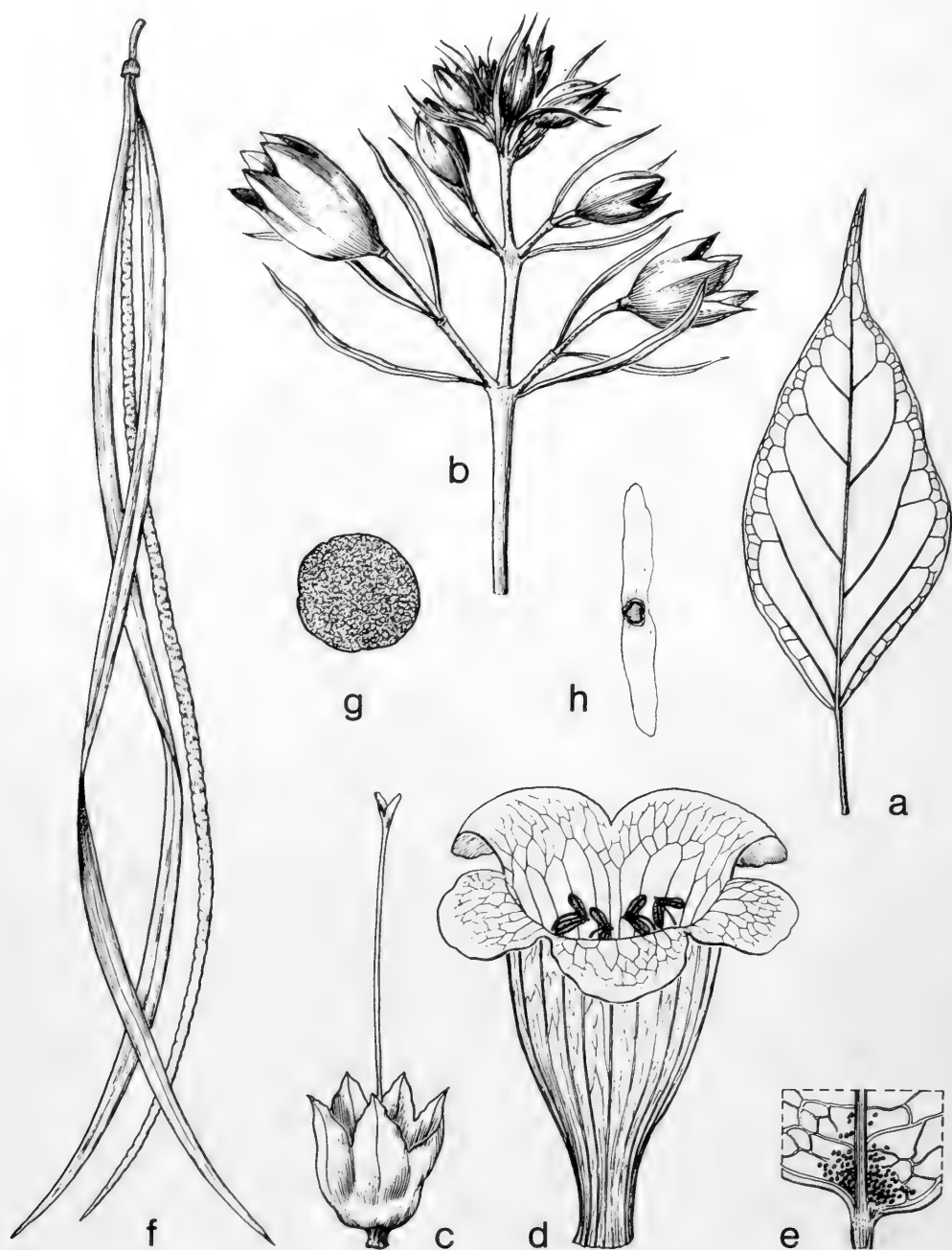


Fig. 20. *Radermachera peninsularis* STEEN. a. Leaflet, b. apex of thyrse, c. calyx and style, d. corolla, all nat. size. — *R. glandulosa* (BL.) MIQ. e. Leaf base, underneath with dense glandfield, $\times 2$, f. empty capsule, with 2 valves and septum, $\times \frac{1}{2}$, g. section of septum, $\times 5$, h. seed, $\times 2$ (a-d LARSEN c.s. 31239, e-h KOSTERMANS 6360A).

Radermachera et Xylocarpaea B. & H. Gen. Pl. 2 (1876) 1047; CLARKE, Fl. Br. Ind. 4 (1884) 383; K. & V. Bijdr. Booms. 1 (1894) 71. — *Radermachera* sect. *Alatae* STEEN. Acta Bot. Neerl. 2 (1953) 307. — **Fig. 20, 22.**

Trees, rarely shrubs, evergreen (except 2 Indian and 2 Chinese *spp.*). Twigs and floral rachis mostly distinctly lenticellate. Innovations sticky-lacquered. *Leaves* 2–3-pinnate; stalks and leaflets articulated; rachis sulcate; leaflets underneath minutely but densely dotted, furthermore with gland-fields or scattered glands underneath, mostly acuminate, very rarely laxly puberulous. *Thyrses* terminal, very rarely ramiflorous, in one *sp.* a raceme; bracts and bracteoles inconspicuous, very rarely leafy; thyrses (and calyx) very rarely short-hairy. *Flowers* white, pink with yellow streaks in mouth, more rarely greenish yellow, or golden yellow to orange-red. *Calyx* closed in bud, rarely lobed from the beginning, splitting spathaceously (not to the base) or mostly irregularly lobed, rarely stunted, often with microscopical scale-like glands, moreover mostly with larger crateriform glands; after anthesis almost always circumscissile-dehiscing at the base, along an abscission line, in one *sp.* persistent. *Corolla* either salver- or narrow funnel-shaped or more commonly with a mostly short basal tube and often rather suddenly widened into an upper tube; lobes mostly rounded unequal, not rarely ciliate. *Stamens* didynamous with a 5th rudiment, but in one Chinese *sp.* 5 equal stamens, not exerted; anther-cells V-shaped divergent; filaments inserted at the apex of the basal tube, except in two *spp.* capitate-glandular hairy at the insertion and in the basal part, for the rest glabrous; connective produced. *Ovary* elongate often minutely lepidote, glabrous, or tuberculate, never hairy; in both cells with several rows of ovules; style filiform, mostly exceeding the anthers; stigma 2-lipped. *Capsule* linear, terete, up to 75 cm; valves smooth, pergamentaceous, rarely \pm woody, in one *sp.* tuberculate; septum terete, brittle, corky, but with shallow impressions of the flat seeds, a narrow line on both sides testimony of attachment to the middle of the valves. *Seeds* very ∞ , flat, small, narrow, on both ends with a hyaline wing.

Distr. About 15 *spp.* in Indo-Malesia, from the Deccan to S. China, Hainan, Formosa, and the southern Ryū Kyūs, most abundant in tropical SE. Asia; throughout *Malesia*, but not in the Moluccas proper and New Guinea. Fig. 21.

Ecol. Lowland primary and secondary rain-forests, up to c. 1500 m, not rarely pioneering in disturbed forest and on slopes.

Flower colour and corolla shape vary from pure white to orange-red and from hypocrateriform (*R. sinica* (HANCE) HEMSL. and *R. frondosa* CHUN & HOW) to tubular or campanulate. For the narrow-tubular orange-flowered species pollination by birds can be expected (*R. ramiflora*) and for the pure white, possibly nocturnal *R. peninsularis* hawk-moths may be the pollinating insects.

Ramiflory is found in *Malesia* in *R. ramiflora*; it occurs also occasionally in poor forms of *R. pinnata* after leader-shoots have been damaged. In continental Asia it is also found in *R. ignea* (KURZ) STEEN. and in *R. hainanensis* MERR.

Uses. Minor uses, see under the species.

Syst. Related to *Stereospermum*, which differs radically in having only two rows of ovules in each cell, and thick trigonous seeds with folded cotyledons fitting in cavities of the septum; moreover, its leaves are always 1-pinnate and most species are deciduous and prefer a seasonal climate.

Two small genera have recently been split off, both from SE. Asia, viz the monotypic *Pauldopia* STEEN. (Acta Bot. Neerl. 18, 1969, 425) which has winged rachises, a curved corolla tube, wingless thickish seed, a very thin septum, and a truncate calyx open in bud; and *Barnettia* SANTISUK (Kew Bull. 28, 1973, 172) with 2 *spp.* in Thailand, with 1-pinnate leaves in pseudowhorls, a short-ellipsoid, \pm compressed capsule, and tuberculate or immersed-glandular calyx and capsule and a cruciform septum; the latter genus shows relationship with *Heterophragma*.

The closest ally of *Radermachera* is obviously the Afro-Asian genus *Fernandoa* (cf. STEEN. Blumea 23, 1976, 133) from which it differs by the terete septum, the usually not ribbed or striate and thinner,

narrower fruit valves, mostly 2–4-pinnate leaves, absence of domatia underneath the leaflets, and mostly crateriform glands.

Notes. Specific delimitation, especially in Malesian material, proved difficult, as several species appear to be variable and many were only known from the type, notably in the Philippine Islands. Degree of pinnation is variable, often in one collection. Also the number and place of the larger glands on under-surface of leaflets and on the calyx is liable to variation, as well as the flower colour and the way in which the calyx splits. A critical scrutiny showed only few tangible characters and resulted into a severe reduction of species in Malesia.

KEY TO THE SPECIES

1. Calyx strongly lengthwise 5–6-ridged, $1\frac{3}{4}$ cm, narrow, one side cleft down \pm halfway, 3-toothed at apex. Leaves 1-pinnate, with 5 leaflets, coriaceous, very glossy above, with recurved edge, 7–14 by 3–4 cm. Corolla 4 cm, with narrow tube, slightly enlarged above; lobes c. 1 cm, obtuse. 6. *R. coriacea*
1. Calyx not lengthwise 5–6-ridged.
2. Corolla narrowly funnel-shaped, without distinction of basal and upper tube. Flowers in cauliflorous racemes, with yellow tube and red limb. Leaves 2-pinnate 1. *R. ramiflora*
2. Corolla with a cylindric basal tube, widened rather abruptly into an upper tube. Flowers in terminal thyrses which are rarely raceme-like depauperated.
3. Calyx very short (3–5 mm), with a stunted rim, persistent. Leaves always 1-pinnate 2. *R. glandulosa*
3. Calyx longer, irregularly lobed, after anthesis circumscissile-caducous.
4. Corolla 2– $3\frac{1}{2}$ –($4\frac{1}{4}$) cm long (incl. lobes). Calyx 5–10(–13) mm long 3. *R. pinnata*
4. Corolla 5–6 cm long. Calyx 10–25 mm.
5. Filaments and inside of basal tube glabrous. Corolla tube outside towards apex and on lobes with minute sessile glands. Leaves above puberulous on midrib and nerves, beneath with some scattered glands. Corolla white or cream-coloured 4. *R. peninsularis*
5. Filaments and inside of basal tube near insertions capitate-glandular hairy. Corolla tube outside towards apex mostly laxly and very short-hairy. Leaves glabrous above, beneath mostly with at least a gland-field at base. Corolla mostly pinkish, sometimes white, with yellow streaks in the mouth 5. *R. gigantea*

1. *Radermachera ramiflora* STEEN. J. Bot. 72 (1934) 5; Blumea 23 (1976) 129.

Large tree, 24–30 m, stem 30–60 cm \varnothing ; fluted at base; bark grey, fissured. Innovations and racemes lacquered, resinous sticky. Leaves (2–)3-pinnate, up to 1 m, more or less crowded at the twig-ends; pinnae 4–6 pairs; leaflets elliptic-lanceolate, acuminate at both ends, stalked, $3\frac{1}{2}$ – $8\frac{1}{2}$ by $1\frac{1}{2}$ – $3\frac{1}{2}$ cm, underneath fine glandular-punctate and with scattered small, shallow glands especially near the base, and a few scattered flat glandular spots. Flowers thickly set in closely placed ramiflorous pendent racemes to 20 cm long, erect on curved pedicels 1–2 cm long and with 3 bracteoles \pm halfway on an articulation. Calyx in bud pear-shaped, closed, reddish green, tubular, 2–3-lobed, eglandular outside, microscopically glandular-papillose inside, c. $2\frac{1}{4}$ – $2\frac{1}{2}$ cm long, 1 cm \varnothing at mouth, lobes 4–6 mm, 1–2 split \pm halfway. Corolla with yellow tube and red limb; tube slightly curved, narrow salver-shaped, without narrowed basal tube, 5–7 cm, the basal $1\frac{1}{2}$ cm densely pubescent with thick hairs, mouth $1\frac{1}{2}$ –2 cm \varnothing ; lobes rounded, subequal, \pm 1 cm \varnothing , \pm papillose inside. Stamens (and style) reaching the mouth, inserted halfway the tube, glabrous but their adnate base lax glandular-papillose, thecae \pm divergent, 4–5 mm; no produced connective. Disk thick, annular-cup-shaped, faintly crenate. Ovary ribbed, pistil c. 4 cm, stigmatic lobes 2 mm, very narrow. Capsule straight or twisted, 35–70 cm, c. 5 mm \varnothing ; septum $2\frac{1}{4}$ –3 mm \varnothing . Seeds 4–5 by $2\frac{1}{2}$ mm, the wings 6–7 mm.

Distr. Malesia: Sabah, Mt Kinabalu (Penibukan, Dallas, Mesilau, Tenempok, Kota Belud, Kp. Kiau I resthouse), not rare.

Ecol. Rain-forest, also in disturbed forest on hill side, 950–1500 m. Fl. Aug., Jan.–March, fr. April, Dec.

Notes. A characteristic, isolated species: ramiflorous, flowers in racemes, shape of corolla.

Leaflets of suckers and saplings dentate. NOOTEBOOM & ABAN 1603 has only 2-pinnate leaves, CLEMENS 30364 has them 2–3-pinnate.

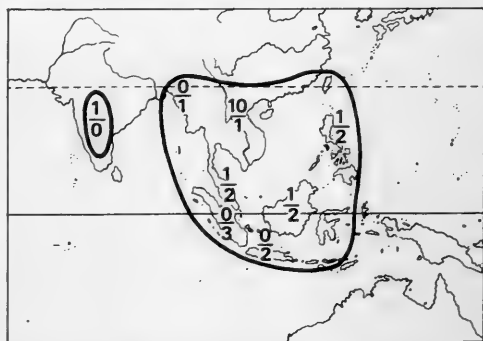


Fig. 21. Range of the genus *Radermachera* Z. & M.

2. *Radermachera glandulosa* (BL.) MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 250; K. & G. J. As. Soc. Beng. 74, ii (1905) 380; KOORD. Atlas Baum. 2 (1914) t. 356; STEEN. Thesis (1927) 965; Bull. Jard. Bot. Btjg III, 10 (1928) 241; CORNER, Ways. Trees (1940) 168, f. 43; CHATTERJEE, Bull. Bot. Soc. Beng.

2 (1948) 74; STEEN. Acta Bot. Neerl. 2 (1953) 307; BACK. & BAKH. f. Fl. Java 2 (1965) 541; SANTISUK, Thai For. Bull. Bot. 8 (1974) 27, f. 15; STEEN. Blumea 23 (1976) 126. — *Spathodea glandulosa* BL. Bijdr. (1826) 762. — *Bignonia porteriana* WALL. ex DC. Prod. 9 (1845) 165. — *R. stricta* Z. & M. ex ZOLL. Syst. Verz. 3 (1855) 53; RIDL. Fl. Mal. Pen. 2 (1923) 550. — *Stereospermum glandulosum* MIQ. Suppl. (1860) 240, 565; CLARKE, Fl. Br. Ind. 4 (1884) 383; K. & V. Bijdr. Booms. 1 (1894) 74; KANJILAL & DAS, Fl. Assam 3 (1939) 404. — *Lagaropyxis glandulosa* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 199. — Fig. 20e-h.

Small, glabrous, evergreen, crooked tree, up to 12 m, 40 cm \varnothing ; bark slightly pimply and peeling, but not flaky or fissured, bitter; young leaves deep purple, acrid. Leaves 1-pinnate; leaflets 2-5 pairs, large, chartaceous, elliptic (mostly broad-), rarely oblong-lanceolate, short-tipped, with a conspicuous dark, dense gland-field at the oblique base underneath (often bulging on upper surface), 10-30 by 5-17 cm. Thyse narrow, 6-50 cm, gradually elongating, sometimes the upper part still flowering while lower are in fruit. Calyx 3-5 mm, cup-shaped, without abscission line, persistent, truncate, purple, spotted with 5-7 purple glands in a crescent. Corolla narrow, slender, tube narrow, slightly curved, halfway rather gradually widening, 3(-4) cm, pinkish purple outside, white inside, with a gland-field at outside of the ciliate lobes, basal part of lower tube short capitate-glandular hairy inside. Stamens hairy at insertion. Pods hanging in bunches, straight, 15-30 cm; valves 5-7 mm wide; septum 3-4 mm \varnothing . Seeds 10-16 by $1\frac{1}{2}$ -2 mm.

Distr. Continental SE. Asia (Assam, Burma, Thailand, Laos, China: Kwangsi, Kwantung) and West Malasia: Malay Peninsula (also Penang), Sumatra, Krakatao, West to East Java.

The two records from Borneo are erroneous: the KORTHALS specimens are mislocalized and BECCARI 811 (mentioned by MERRILL, En. Born. 1921, 525) is a PS number. Both are from Sumatra.

Ecol. Primary and secondary forests and thickets, frequently by streamsides, even rocky *Saraca*-streams (CORNER), both under everwet and under seasonal conditions (in Central and East Java), from sea-level to 900 m, once reported from 5000 ft (Cameroon Highlands). Fl. April, July-Nov., fr. Jan.-Dec.

The fine seed would indicate easy dispersal, but though the species is found in Penang and Krakatao Is., it has never been collected in the Riau Is., not in the islands west of Sumatra and also not in those close to East Java (Madura I., Bali, and Kangean) though it is found in Java as far east as Bali Straits and *R. gigantea* extends east as far as Alor. The glands at the leaflet basis are often black from sooty moulds indicating actual glandular excretion.

Uses. The timber is small and of negligible value.

Vern. *Tuwi gadang*, M, Minangkabau; *kia bako*, *ki hapit*, *ki langhit*, *kipahit*, *ki sakat*, *ki sikap*, S; *ambal*, *bangking*, *bangkongan*, *djelibru*, *godong ambol*, *hambal*, *kawuk* = *gabret*, *klaju*, *lambal*, *padall*, *pedali*, *pudang*, J; *sekar potè*, Md.

3. *Radermachera pinnata* (BLANCO) SEEM. J. Bot. 8

(1870) 147; MERR. Philip. J. Sc. 3 (1908) Bot. 336, incl. var. *glabra* MERR. l.c.; Sp. Blanc. (1918) 350; En. Philip. 3 (1923) 446; STEEN. Thesis (1927) 973; Bull. Jard. Bot. Btzig III, 10 (1928) 248; Blumea 23 (1976) 129. — *Millingtonia pinnata* BLANCO, Fl. Filip. (1837) 501. — *Millingtonia quadripinnata* BLANCO, l.c.; ed. 3, 2 (1878) 286, t. 252. — *R. banaibana* BUREAU, Adansonia 2 (1861) 194. — *R. quadripinna* SEEM. J. Bot. 8 (1870) 147. — *Stereospermum pinnatum* F.-VILL. Nov. App. (1880) 151; ROLFE, J. Linn. Soc. 23 (1884) 314; VIDAL, Phan. Cuming. Philip. (1885) 132; Rev. Pl. Vasc. Filip. (1886) 203. — *Stereospermum quadripinnatum* F.-VILL. Nov. App. (1880) 151; VIDAL, Syn. Atlas (1883) 35, t. 73. — *Stereospermum banaibanai* ROLFE, J. Linn. Soc. 23 (1884) 314. — *Stereospermum seemannii* ROLFE, l.c. — *R. acuminata* MERR. Philip. J. Sc. 3 (1908) Bot. 335; En. Philip. 3 (1923) 445; STEEN. Thesis (1927) 980. — *R. mindorensis* MERR. Philip. J. Sc. 3 (1908) Bot. 338; En. Philip. 3 (1923) 446; STEEN. Thesis (1927) 971. — *R. fenicis* MERR. Philip. J. Sc. 3 (1908) Bot. 335, 434; En. Philip. 3 (1923) 446; STEEN. Thesis (1927) 979, incl. var. *acuminata* STEEN.; Jard. Bot. Btzig III, 10 (1928) 261. — *R. whitfordii* MERR. Philip. J. Sc. 7 (1912) 352; En. Philip. 3 (1923) 447; STEEN. Thesis (1927) 963. — *R. brachybotrys* MERR. Philip. J. Sc. 26 (1923) 489; ELMER, Leaf. Philip. Bot. 10 (1939) 3809. — *R. sorsogonensis* ELMER ex STEEN. Thesis (1927) 973; ELMER, Leaf. Philip. Bot. 10 (1939) 3809. — *R. elegans* STEEN. Bull. Jard. Bot. Btzig III, 10 (1928) 252, f. 8. — *R. fenicis* (non MERR.) STEEN. l.c. 261, f. 11.

See for other synonyms under *ssp. acuminata*.

Distr. Malasia: Sumatra (also Simalur, Banka, and Siberut Is.), Malaya, Borneo, Philippines, Celebes (also Muna I.), and W. Moluccas (Sula Is.: Taliabu).

Notes. It has appeared impossible to separate the material into smaller species, as there is gradual transition of the many populations, especially in the Philippine islands, notably in vegetative characters. *R. brachybotrys* is merely a depauperate ridge facies. In one specimen 1- and 2-pinnate or binate leaves are not seldom found together. For brevity I have omitted from the synonymy the many pro parte citations under *R. amoena*, *hypostictum* and *gigantea*. Some specimens from Borneo and Celebes show a tendency in leaf-shape towards *ssp. acuminata*.

KEY TO THE SUBSPECIES

1. Leaflets usually chartaceous, elliptic, acuminate to caudate; basal gland field mostly distinct, at apex eglandular or with a few scattered glands
ssp. pinnata
1. Leaflets firmly chartaceous to coriaceous with consequently less marked prominent venation beneath, usually obovate to elliptic-obovate, at apex mostly short- and blunt-tipped or blunt or rounded; basal gland field dense, often one also at apex *ssp. acuminata*

ssp. pinnata.

Tree to 20 m, 15-40 cm \varnothing . Leaves (1-)2-3-pinnate, 25-50(-70) cm; leaflets elliptic-oblong, acuminate, mostly at both ends, to caudate, (3-)5-16 by ($1\frac{1}{2}$)-2-5(-8) cm, usually chartaceous,



Fig. 22. *Radermachera pinnata* (BLANCO) SEEM. *ssp. acuminata* (STEEN.) STEEN. Habit, in flower, Aug. 1970 (photogr. B. C. STONE).

with a basal gland field, apical gland field absent or of scattered glands. Thyrses glabrous, sometimes puberulous, (3–6)15–60 cm, in odd specimens sometimes on the old wood. Calyx $\frac{1}{2}$ –1(– $1\frac{1}{2}$?) cm, lobes unequal, (1–)2–4, glabrous, usually glandless. Corolla pink to pale purplish, with yellow markings in the throat, 2– $3\frac{1}{2}$ (– $4\frac{1}{2}$) cm, rarely slightly lax short-hairy. Stamens glandular-hairy at their insertion. Ovary and style glabrous, 12–17(–22) mm. Capsule (6–)30–50 cm; valves 4–6(–7) mm wide; septum 2– $2\frac{1}{2}$ mm \varnothing . Seeds (7–)13–15 by 2–3 mm.

Distr. *Malesia*: Philippines (the most common species), Celebes (also in Muna I.), Moluccas (Sula Is.: Taliabu).

Ecol. Lowland and montane primary and secondary forests, on streamsides, up to 600 m. Fl. Aug.–May, fr. Febr.–Nov.

Uses. Minor uses only, for carving and fuel.

Vern. Philippines: *banai-banai*, Tag., the common name, *kalapuing*, *salai*, *tuang-huló*, *ulimbabon*, *yabang-yabang*, Tag., *banoi-banoi*, Bag., *ansohan*, *badlan*, Bis., *labayanan*, C.Bis., *paling-uák*, Bik., *pagalayan*, Bon., *bunglai*, Buk., *atiatip*, Ig., *lanunisi*, *lasilak*, Ibn., *barangauan*, Ilk., *bunlai*, Mbo., *banaibayan*, *paitan*, *pata*, Pang., *bani-bani*, Sbl., *kutokong*, Sub., *hali-háli*, Sulu; Celebes: *ririh*, Muna.

Note. In a few specimens some inflorescences are ramiflorous, obviously due to damage of the leader shoot.

ssp. acuminata (STEEN.) STEEN. Blumea 23 (1976) 129. — *Spathodea lobbii* T. & B. Nat. Tijd. N. I.

25 (1863) 413. — *R. lobbii* MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 250; SEEM. J. Bot. 8 (1870) 147; STEEN. Bull. Jard. Bot. Btzig III, 10 (1928) 243, f. 5, incl. *ssp. acuminata* STEEN. l.c. 247, f. 6; CORNER, Ways. Trees (1940) 168, f. 43 ('*lobbiana*'); SANTISUK, Thai For. Bull. Bot. 8 (1974) 29. — *R. amoena* [non (WALL.) SEEM.] GAMBLE, J. As. Soc. Beng. 74, ii (1905) 381; RIDL. Fl. Mal. Pen. 2 (1920) 551. — *R. corymbosa* STEEN. Bull. Jard. Bot. Btzig III, 10 (1928) 249, f. 7. — *R. gigantea* [non (BL.) MIQ.] BURK. Dict. (1935). — Fig. 22.

Tree, 7–40 m, 60 cm \varnothing . Leaves biternate or 2-pinnate; leaflets rather coriaceous, obovate to obovate-elliptic, not or short- and blunt-tipped, exceptionally acuminate, basal gland field well-developed, apical one usually distinct, 8–15 by $3\frac{1}{2}$ – $7\frac{1}{2}$ cm. Thyrses apical, fairly narrow, 15–25 cm. Calyx 1 cm, rarely to $1\frac{1}{2}$ cm. Basal tube of corolla rather suddenly widened.

Distr. S. Peninsular Thailand (Krabi, Pattani); in *Malesia*: Sumatra (also in Banka; Mentawai Is.: Siberut; Simalur I.), Malaya, Borneo, SW. Philippines (Palawan, Culion).

Ecol. Primary and secondary forests, also in open grasslands. In Malaya especially by streams (CORNER), on granite as well as on limestone; at 0–400(–800) m. Fl. May, July–March, fr. May–Nov.

Taxon. Formerly often accepted as conspecific (also by myself, 1927) with *R. gigantea* *cq. amoena*, but certainly distinct.

Vern. Sumatra: *kaju singamba*, *sindur langit*, *sundur langit*, Batak, *kudo kudo pajo*, Simalur, *mentu*, *tuih*, *tuwi(k)*, Banka; *kapung suwi*, *kéka-*

pung, Lampung; *bunga pawang*, *setengah burung*, *tangkani*, Malaya; Borneo: *binutan*, *kudjuk langit*, Dajak-Kapuas; Culion: *totancola*, Tagb.

Note. I must admit that I have somewhat hesitantly kept this apart as a subspecies from true *R. pinnata*, from which it differs only in shape and texture of leaflets and geographical range. There are some specimens in Borneo which seem transitional.

In the Philippines (Palawan and Culion) aberrant specimens are found with biternate leaves and rather prominent veins underneath. They were collected in grasslands which may account for their habit. However, in the same islands there are also larger-flowered specimens which I have referred to *R. gigantea* with similar habit. More field work in these islands is needed to check my tentative conclusions.

4. *Radermachera peninsularis* STEEN. *Blumea* 23 (1976) 128, f. la-d. — *R. borii* (non FISCHER) SANTISUK, Thai For. Bull. Bot. 8 (1974) 30. — Fig. 20a-d.

Tree, 4–15 m. *Leaves* 3-pinnate, 60–80 cm; leaflets lanceolate-oblong, falcate-caudate, 5–8 by 2–3 cm, on both surfaces microscopically punctate but only with a few scattered, very small 'larger' glands; midrib and main nerves (c. 4–5 pairs) puberulous above (as in *R. sinica*). *Inflorescences* terminal, similar to those in *R. sinica*; peduncle firm, 15–35 cm long, rachis 4–7 cm; full-grown pedicels $2\frac{1}{2}$ –7 cm, halfway with 2 decussate linear bracteoles c. $1\frac{1}{2}$ –3 cm long. Bracts long, linear, exceeding the buds, the lowest up to 5 cm long, upper ones $2\frac{1}{2}$ –3 cm. *Calyx* campanulate, rather wide and thickish, densely microscopically lepidote, $2\frac{1}{2}$ by $1\frac{1}{2}$ cm, rather irregularly lobed for $\frac{1}{3}$ – $\frac{2}{3}$ of its length, with 5 \pm distinct gland fields. *Corolla* white or creamy, c. 6–7 cm long (incl. the entire lobes), with a rather wide ($\frac{3}{4}$ cm) basal tube c. $1\frac{1}{2}$ cm long concealed in the calyx on top of which the filaments are inserted; upper tube funnel-shaped widened. *Filaments* c. 3 cm, glabrous; anthers $4\frac{1}{2}$ mm; connective appendage small. *Ovary* glabrous. *Capsule* terete, tortuous, 60–70 cm by 3–5 mm.

Distr. Peninsular Thailand (between Phangnga and Krabi); in *Malesia*: Malay Peninsula (Cameron Highlands), 2 collections.

Ecol. In Peninsular Thailand at 8°25' N, 99°15' E, in evergreen forest along a stream, on limestone, at 50 m altitude, in the Cameron Highlands at 1200 m in mixed rain-forest.

Notes. In habit deceptively like *R. sinica*, but at once different by the shorter (6–7 cm), not salver-shaped corolla and the much wider smooth calyx. The corolla in *R. sinica* measures c. 8–12 cm including the lobes, with a narrow, very gradually widening tube. *R. sinica* also has the minute lax pubescent nerves and veins above and long narrow bracts.

SANTISUK *l.c.* referred the specimens to *R. borii*, which I refer to *R. sinica*, a species ranging more northerly in SE. Asia, viz from N. Assam, N. Burma, and Tonkin to S. China, Hainan, Formosa, and the southern Ryu Kyu Is.

5. *Radermachera gigantea* (BL.) MIQ. *Ann. Mus.*

Bot. Lugd.-Bat. 3 (1867) 250; SEEM. *J. Bot.* 8 (1870) 146; KOORD. Atlas Baum. 2 (1914) t. 356 A-K; HEYNE, *Nutt. Pl.* (1927) 1371; STEEN. *Thesis* (1927) 983, p.p., excl. *syn. lobbii*; Bull. Jard. Bot. Btzig III, 10 (1928) 253, f. 9; *Blumea* 23 (1976) 126. — *Bignonia gigantea* NORONA, *Verh. Bat. Gen.* 5 (1790) 70, *nomen*. — *Spathodea gigantea* BL. *Bijdr.* (1826) 761; MIQ. *Fl. Ind. Bat.* 2 (1858) 751. — *Bignonia amoena* WALL. [Cat. (1832) n. 6512, *nomen*] Pl. As. Rar. 2 (1831) 78, t. 183; LOUDON, *Hort. Brit.* (1830) 483, *err. amara*; G. DON, *Gen. Hist.* 4 (1838) 222. — *Bignonia oxyphylla* DC. *Prod.* 9 (1845) 169. — *Stereospermum hypostictum* MIQ. *Sum.* (1861) 565; CLARKE, *Fl. Br. Ind.* 4 (1884) 384, *excl. syn. S. lobbii*; K. & V. *Bijdr. Booms.* 1 (1894) 72, *excl. syn. lobbii*; KANJILAL & DAS, *Fl. Assam* 3 (1939) 405. — *Lagaropyxis gigantea* MIQ. *Ann. Mus. Bot. Lugd.-Bat.* 1 (1864) 198, *incl. f. sumatrana et f. borneensis* MIQ. — *R. amoena* SEEM. *J. Bot.* 8 (1870) 146; non GAMBLE, *J. As. Soc. Beng.* 74, ii (1905) 381, *quae est R. lobbii*. — *R. elmeri* MERR. *Bull. Gov. Lab. Philip.* 29 (1905) 48; Philip. *J. Sc.* 3 (1908) Bot. 334; En. Philip. 3 (1923) 445; STEEN. *Thesis* (1927) 994. — *R. biternata* MERR. *Philip. J. Sc.* 1 (1906) Suppl. 238; *ibid.* 3 (1908) Bot. 333; En. Philip. 3 (1923) 445; STEEN. *Thesis* (1927) 970. — *R. palawanensis* MERR. *Philip. J. Sc.* 3 (1908) Bot. 336; STEEN. *Thesis* (1927) 977. — *R. elliptica* MERR. *Philip. J. Sc.* 3 (1908) Bot. 334; En. Philip. 3 (1923) 445; STEEN. *Thesis* (1927) 964. — *R. sibuyanensis* ELMER, *Leaf. Philip. Bot.* 4 (1912) 1485; MERR. *En. Philip.* 3 (1923) 447; STEEN. *Thesis* (1927) 992. — *R. elmeri* var. *fragrans* ELMER, *Leaf. Philip. Bot.* 7 (1915) 2561; MERR. *En. Philip.* 3 (1923) 446. — *R. fragrans* STEEN. *Thesis* (1927) 996. — *R. punctata* ELMER ex STEEN. *Thesis* (1927) 982; ELMER, *Leaf.* 10 (1939) 3709. — *R. borneensis* STEEN. *Bull. Jard. Bot. Btzig III*, 10 (1928) 258, f. 10.

Shrub or tree, (6–)20–40 m, up to 80 cm \varnothing ; bark and young leaves bitter. *Leaves* (1–)2(–3)-pinnate, 12–35(–80) cm, leaflets usually elliptic to oblong, rarely somewhat obovate or lanceolate, shorter or longer acuminate, 4–12(–15) by 2–6(–9) cm, at base underneath mostly with a gland-field, at apex with some scattered glands. *Thyrse* 8–40 cm, rather open, terminal, ∞ -flowered, glabrous. *Flowers* not rarely fragrant. *Calyx* (1–)1 $\frac{1}{4}$ –2 $\frac{1}{2}$ cm long, mostly 2-lobed, sometimes 1- or more-lobed; glands few or distinct. *Corolla* 5–6 cm long (incl. lobes), pink or white, usually with yellow streaks in the mouth, above the basal tube rather suddenly widened, campanulate upper tube towards apex almost always short-capitate glandular hairy, and lobes ciliate. *Filaments* densely capitate-glandular hairy at insertion. *Style* $2\frac{1}{2}$ –3 cm. *Capsule* 15–60 cm long, 5–8 mm \varnothing ; septum 4 mm \varnothing . *Seeds* 8–13 by 2–4 mm.

Distr. SE. Asia (Assam: Khasi & Jaintia Hills; Burma: Manipur, Tavoy, WALLICH, CLARKE, *l.c.*, not seen), and *Malesia*: Sumatra (incl. Billiton and Banka), West to East Java (common in Central and East Java), Lesser Sunda Is. (Bali, Sumbawa, Flores, Alor), Bawean I., SE. Borneo, and Philippines.

Ecol. Primary and secondary forests, also in areas subject to a dry monsoon, and in East Java in teak forest, very common on Mt Telemojo and near Pringombo (Banjumas) (KOORDERS, *l.c.*),



Fig. 23. *Fernandoa macroloba* (MIQ.) STEEN. a. Habit of branchlet with young fruit, $\times \frac{1}{2}$, b. inflorescence in bud, $\times \frac{1}{2}$, c. calyx, nat. size, d. corolla, $\times \frac{3}{4}$, e. CS of young capsule, nat. size, f. mature capsule, $\times \frac{1}{2}$, g. seed, nat. size, h. detail of underside of leaflet, showing small domatia and flat gland, $\times 4$, (a-e, h C.H.B. XI-C-106a, f-g DIEPENHORST 2353 HB, type).

from the lowland up to c. 1600 m. *Fl.* Jan.–Dec., *fr.* Jan.–Dec. Not rarely a pioneer in secondary forest, cuttings sometimes used for strengthening terracing on unstable slopes. Early flowering and fruiting as a shrub.

Uses. Sometimes cultivated; also suitable for re-afforestation. Timber is said to be strong and durable, locally used for bridges and houses, but not resistant against termites, and therefore of less value for outdoor constructions; used for making matches and matchboxes (HEYNE, *l.c.*).

Vern. Sumatra: *tui* (*batu*), M, Billiton, Minangk., *djamatan*, *djamaton*, *kaju angin*, *kaju dèling*, *radja matan*, *simaisaludang*, *sundèr langit*, M, Karo-Batak, *tangkè*, M, Atjeh, *kulit bëriling*, M, Kroeï, (*kè*)*kapung tui*, *talas*, M, Lampong; West Java: *ki padali*, S; East Java: *bèdali* (common name), *kédah*, (*kè*)*dali*, *kokok-kèjok*, J, *kaju raras*, *karpotèh*, *potian*, *putian*, *sèkar pètak*, *sèkar potè*, Md; *pèdantèn*, Bali; *atodjang*, Alor; Borneo: *binutan*, Dajak, Martapura, *bunglai batu*, b. *gunung*; Philippines: Palawan: *agtap*, *tantañgan*, Tagb., *sayo*, Ig., *barangau-a-nalabāga*, *pamaya-bayen*, Ilk.

Notes. I have come to the conclusion that the large-flowered species of the Philippines, *R. borneensis* and *R. gigantea*, should be referred to one variable taxon. Though there may be local races they can not be properly distinguished, not even on subspecific level, as their 'characters' fade away; *R. elliptica* with 1-pinnate leaves goes via biternate leaves to 2-pinnate leaves. *R. sibuyanensis* has an almost glabrous corolla; *R. fragrans* has fragrant flowers, but fragrancy is mentioned frequently on labels, but also sometimes flowers are said to be scentless. Flower colour is said to be white or pink in the Philippines, to which mostly is added the occurrence of yellow streaks in the mouth. White flowers are only reported from Borneo and the Philippines.

Especially a few Philippine specimens from Palawan and Culion are aberrant; earlier collections were described by MERRILL as *R. palawanensis* and *R. biternata*. They were collected in grasslands and differ by thicker, often biternate leaves, leaflets with recurved margin and often distinctly arching prominent veins on the undersurface. One number

(PNH 12319) has singularly slender tubular flowers 5 cm long. Other specimens with the same vegetative difference from normal *R. gigantea* have, however, smaller flowers (3–3½ cm) and these I have identified as *R. pinnata ssp. acuminata*. I must admit that closer field work is needed to check my tentative conclusions.

R. amoena (WALL.) SEEM. was described from a flowering shrub in Hort. Calc. which WALLICH found worthy of an ornamental. WALLICH was somewhat doubtful about its provenance, but assumed that it was introduced by Mr C. TELFAIR from Mauritius, where it must then also have been cultivated. Though it is not known from Malaya and Thailand, it does occur in Assam (Khasia & Jaintia Hills, cf. KANJILAL & DAS) and N. Burma (Manipur: MEEBOLD 5169). These specimens I cannot distinguish from *R. gigantea*. What KANJILAL & DAS mean in their key by 'rusty-coloured capsules' is not clear to me; they mention the flowers to be white.

Insufficiently known

6. *Radermachera coriacea* MERR. Philip. J. Sc. 3 (1908) Bot. 333; En. Philip. 3 (1923) 445; STEEN. Thesis (1927) 961; Blumea 23 (1976) 131.

Leaves 1-pinnate, 20–30 cm; leaflets 5, coriaceous, oblong to elliptic-oblong, base acute, apex blunt or obscurely blunt-tipped, margin recurved, 7–14 by 3–4 cm, very glossy above; nerves 13 pairs. Panicles 15 cm. Calyx 1¾ cm, narrow, strongly lengthwise 5–6-ridged, cleft on one side halfway, 3-toothed at apex. Corolla 4 cm, the tube rather narrow, slightly enlarged above, the lobes obtuse c. 1 cm. Capsule 16 cm, valves 5–7 mm wide (*ex descr.*).

Distr. *Malesia*: Philippines: Central E. Luzon (Tayabas Prov.: Baler), only known from the type (MERRILL 1099); vern. name *bibit parang*.

Note. This is the only specific name in the genus of which I could not trace the type, which may be lost. A lengthwise ridged calyx I have not observed in any species of the genus; the 1-pinnate leaves and narrow leaflets seem rather characteristic. It might possibly be an extreme form of *R. pinnata ssp. acuminata*.

10. FERNANDOA

WELW. *ex* SEEM. J. Bot. 3 (1865) 330, t. 37–38, *sphalma Ferdinandia*; *ibid.* 4 (1866) 123; *ibid.* 8 (1870) 280, *sphalma Ferdinandia*; *ibid.* 9 (1871) 81; MILNE-REDHEAD, Kew Bull. 3 (1948) 171; HEINE, *Adansonia* 4 (1964) 467–470; GENTRY, Ann. Mo. Bot. Gard. 62 (1975) 480; STEEN. Blumea 23 (1976) 133. — *Kigelianthe* BAILL. Hist. Pl. 10 (1891) 50. — *Haplophragma* P.DOP, Bull. Soc. Bot. Fr. 72 (1925) 889; STEEN. Thesis (1927) 998; Bull. Jard. Bot. Btzg III, 10 (1928) 262. — *Spathodeopsis* P.DOP, C. R. Ac. Sc. Paris 189 (1929) 1097. — *Hexaneurocarpon* P.DOP, *l.c.* — *Tisseranthodendron* SILLANS, Bull. Soc. Bot. Fr. 98 (1951) 270–272, pl. — **Fig. 23, 25.**

Trees. Leaves 1-pinnate; leaflets 2–5 pairs, diminishing in size downwards, terminal one largest, beneath glabrous or tomentose with stellate hairs, with few

scattered, larger, flat, spot-like glands and small hairy domatia in the nerve-axils. *Thyrse* axillary or terminal, densely or laxly tomentose, or at least almost always with (sometimes) small and appressed stellate hairs. *Calyx* tubular or campanulate, unequally 2–5-lobed, with few to many warty or prominent glands in the upper half. *Corolla* with a fairly large basal tube, rather suddenly campanulate-funnel-shaped widened to the mouth; lobes undulate to crenate. *Stamens* 4, didynamous; 5th rudimentary; anthers divaricate. *Disk* annular. *Ovary* elongate, with 2 marginal placentas in each cell; ovules ∞. *Capsule* long, linear, terete, twisted or straight, pendent, smooth or ribbed; septum flat, smooth, not rarely glossy, thickish. *Seeds* numerous, rather rectangular, the wings rather narrow; insertion punctiform.

Distr. About 4 *spp.* in tropical West Africa (Angola to Gabon) and East Africa (Tanganyika), 3 in Madagascar, and 6 in Indo-Malesia (India to Indo-China); in *Malesia* 2 *spp.*, in the Malay Peninsula and N. Sumatra. Fig. 24.

Ecol. Tropical lowland forest.

Taxon. In *Blumea l.c.* I have given the reasons for uniting all these genera, by which the range of *Fernandoa* is considerably extended and becomes similar to that of *Stereospermum*, *Dolichandrone* and *Markhamia*. It differs from *Markhamia* and *Dolichandrone* in not having a false septum and a spathaceous calyx; it differs from the continental Asian genus *Barnettia* in not having a cruciate septum, shortly ellipsoid-oblong capsules and pseudo-whorled leaves. Its closest ally is *Radermachera* which has thinner, linear-terete capsules which are not striate or ribbed and with thinner valves (except in *R. sinica*), and a terete septum; moreover, the leaves in *Radermachera* are mostly 2–4-pinnate and the leaflets have no domatia and another type of glands and never stellate hairs.

It is noteworthy that *Fernandoa adenophylla* shows in the aspect of flower size and shape, thick indument and especially in the leaves (leaflet texture and size diminishing downwards, often auricles) a striking similarity in habit with *Markhamia* (e.g. *M. cauda-felina*), a genus which may have also ridged pods in Africa: but *Markhamia* has a 4-angled septum and a spathaceous calyx! One gets the impression that there are signs of reticulate affinity among the Afro-Asian genera, and possibly parallel evolution, but it must be observed that several genera are obviously not unnatural in having distinct pollen types.

From its wide distribution *Fernandoa* might be supposed to be an ancient genus, from which *Radermachera*, *Barnettia* SANTISUK (cf. Kew Bull. 28, 1973, 172) and *Stereospermum* are derived specialisations.

Uses. All Indo-Malesian species seem to be good timber trees and of the Indo-Chinese species it is said that the timber is good for all purposes and not attacked by termites. They may already flower and fruit at an early age.

KEY TO THE SPECIES

1. Leaves hairy beneath. Inflorescence terminal, rusty tomentose, with stellate and branched hairs. Calyx thick, campanulate, 2½–3½ cm, woolly-tomentose outside. Corolla thick, 6–7 cm, whitish to yellowish. Capsule twisted, rusty-tomentose, 10-ribbed 1. *F. adenophylla*
1. Leaves glabrous except a few short hairs of the domatia. Inflorescences lateral, with appressed, fine, partly stellate hairs. Calyx tubular, thin, c. 1–1¼ cm by 3 mm, fine appressed stellate-hairy. Corolla thin, pink, short-hairy outside, c. 4–5 cm. Capsule straight or ± twisted, glabrous, smooth. 2. *F. macroloba*

1. *Fernandoa adenophylla* (G. DON) STEEN. *Blumea* 23 (1976) 135. — *Bignonia adenophylla* [WALL. Cat. 6502] ex G. DON, Gen. Syst. 4 (1838) 221. — *Spathodea adenophylla* DC. Prod. 9 (1845) 206; WIGHT, Ill. 1 (1839) t. 160. — *Heterophragma adenophyllum* SEEM. ex B. & H. Gen. Pl. 2 (1875) 1047; KURZ, Fl. Burma 2 (1877) 236; CLARKE, Fl. Br. Ind. 4 (1884) 381; PRAIN, J. As. Soc. Beng. 60, ii (1891) 322; KOORD. Ann. Jard. Bot. Btzig 14 (1897) 417; GAMBLE, Man. (1902) 514; RIDL, Fl. Mal. Pen. 2 (1923) 551. — *Haplophragma adenophyllum* (DC.) P. DOP, Bull. Soc. Bot. Fr. 72 (1925) 890; STEEN. Thesis (1927) 1006, f. 13a, 14e–f; Bull. Jard. Bot. Btzig III, 10 (1928) 265; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 856, f. 14.

Tree, 4–20 m, not rarely poorly developed and

with irregular crown, 10–35 cm Ø; innovations, thyrse and calyx with dark rusty, multicellular compactly branched hairs. *Leaves* 20–50 cm long; leaflets 2–3(–4) pairs, subsessile, the lowest often close to the base of the petiole and smallish and orbicular auricle-like, the terminal leaflet largest, mostly obovate to oblong to elliptic, obtuse to acuminate, underneath with scattered crateriform plate glands and glandular spots and with yellowish-pubescent, stellate hairs (sometimes on short, multicellular stalks), 7–24 by 4–19 cm; petiole 0–8 cm, sulcate as is the rachis. *Thyrse* terminal, stout, erect, lax-flowered, c. 20 cm. *Calyx* campanulate, c. 2½–3½ by 1½–2 cm, inside sordid white, thick, persistent; lobes ½–1 cm, subequal, entire. *Corolla* yellow-brown, white, yellowish

green (brown *in sicco*), outside woolly tomentose, inside glabrous, basal tube c. $1\frac{1}{2}$ –2 cm, upper tube c. 3–4 cm; the mouth c. 5 cm \varnothing ; lobes \pm entire, $1\frac{1}{2}$ – $2\frac{1}{2}$ cm \varnothing . *Anthers* \pm included, cells \pm free. *Ovary* elongate, brown stellate hairy, 1 cm, style 4 cm, \pm exceeding longer stamens. *Capsule* subterete, pendulous, twisted, rusty by stellate hairs, 30–60 by $1\frac{1}{2}$ – $2\frac{1}{2}$ cm \varnothing , the valves with 5 strong prominent ribs; septum flat, shining, corky, over 1 cm wide. *Seeds* variable in size in one capsule, c. $2\frac{1}{2}$ – $3\frac{3}{4}$ by $\frac{3}{4}$ – $1\frac{1}{4}$ cm incl. the smallish wings.

Distr. Continental SE. Asia (Assam to Tenasserim and Chittagong, Burma, Thailand, Indo-China; also in the Andaman and Coco Is.: PRAIN, 1891); in *Malesia*: only in the extreme northern part of Malaya (Langkawi, Perlis: Chupeng; Kedah: Alor Star; in 1882 also found on Bt. Timah in Singapore I.).

Ecol. Mixed deciduous or evergreen monsoon forest, also in bamboo forest often on limestone and calcareous soils, but in Burma preferring pervious siliceous soils (KURZ); 0–750 m. *Fl.* May–Sept., *fr.* March–Sept.

KOSTERMANS (n. 1436) noted that in Thailand the 'white' flowers open at night and drop the next morning. KURZ l.c. stated it leaf-shedding in Burma and flowering at the close of the cold season. VAN DER PIJL (Act. Bot. Neerl. 5, 1956, 138) stated that the nocturnal flowers are visited by bats.

the lowest pair often (2–4 cm) small and roundish, 14–18 by 4–7 cm; underneath some scattered dark glandular spots and minute hairy domatia. *Thyrse*s rather short (2–8 cm), lateral, narrow and dense, densely appressed pubescent; peduncle short; pedicels c. $\frac{1}{2}$ cm. *Calyx* tubular, less than halfway with 2–3 incised, short, acute lobes, $1\frac{1}{4}$ cm by 3 mm, appressed-pubescent by appressed partly stellate hairs and a few warty elevated glands in upper half, faintly 5-ribbed. *Corolla* white or pale pinkish, of thin texture, outside minutely puberulous, 4–5 cm (incl. lobes); basal tube c. $1\frac{3}{4}$ cm long, upper one wide-funnel-shaped, c. $1\frac{1}{4}$ cm long; lobes unequal obovate-roundish, with crenulate margin, $1\frac{1}{2}$ – $1\frac{3}{4}$ by $1\frac{3}{4}$ – $2\frac{1}{4}$ cm. *Stamens* 4, didynamous, inserted halfway the basal tube. *Disk* annular, \pm puberulous. *Ovary* lanceolate, densely yellow-tomentose, 4-angular, faintly 6-ribbed; ovules in 6 rows in each cell; style delicate, $1\frac{1}{2}$ –2 cm, at base appressed-hairy. *Capsule* linear, terete, straight or \pm twisted, glabrous, 40–65 by $1\frac{1}{2}$ cm \varnothing ; valves thin-coriaceous, lenticellate; septum flat, $\frac{3}{4}$ –1 cm wide, shining, of corky texture. *Seeds* 2– $2\frac{1}{2}$ cm (incl. the very short hyaline wing) by $\frac{3}{4}$ cm.

Distr. Malesia: northern half of Sumatra: from the Res. Minangkabau and Pariaman northward to Atjeh and even on P. Breueh.

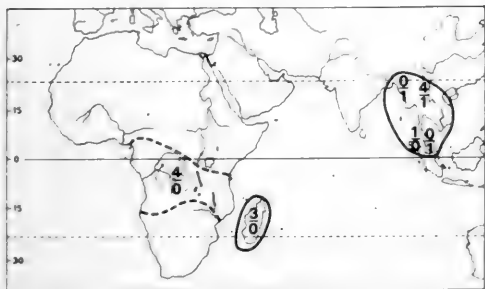


Fig. 24. Range of the genus *Fernandoa* SEEM. Figures above the hyphen indicate endemic species, those below the hyphen non-endemic species for each area or subarea. In Africa and SE. Asia the delimitation is generalized.

2. *Fernandoa macroloba* (MIQ.) STEEN. Blumea 23 (1976) 136. — *Spathodea* sp. TEYSM. Nat. Tijds. N. I. 14 (1857) 345. — *Spathodea macroloba* MIQ. Sum. (1861) 565; HEYNE, Nutt. Pl. ed. 1, 4 (1917) 167. — *Heterophragma macrolobum* BACK. ex HEYNE, Nutt. Pl. ed. 2 (1927) 1371. — *Haplophragma macrolobum* (MIQ.) STEEN. Thesis (1927) 1002, f. 13b, 14a–d; Bull. Jard. Bot. Btzg III, 10 (1928) 263, f. 12. — Fig. 23, 25.

Tall, deciduous tree, 15–40 m (bole 15–20 m), 20–70 cm \varnothing ; no buttresses; larger twigs terete. *Leaves* 25–40 cm; leaflets 3–5 pairs, a few mm stalked to sessile, obovate- to elliptic-oblong, glabrous, beneath with a few large spot-glands, entire, abruptly acute-acuminate, cuneate at base,



Fig. 25. *Fernandoa macroloba* (MIQ.) STEEN. Twig with flowers, nat. size (photogr. HUYSMANS, Nov. 1956).



Fig. 26. *Lamiodendron magnificum* STEEN. a. End of twig, $\times \frac{1}{3}$, b. bud, nat. size, c. ramiflorous raceme, d. terminal raceme, both $\times \frac{1}{3}$, e. LS section of ovary, $\times 3$, f. CS of ditto, $\times 5$ (BRASS 25543).

12. PAJANELIA

A.P.DC. Bibl. Univ. Genève II, 17 (1838) 130, repr. p. 14; A.DC. Prod. 9 (1845) 227; BUREAU, Mon. (1864) 35, 50, t. 20; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1895) 244. — Fig. 27, 29.

Ecol. Rain-forest, up to 350 m, according to field labels in most localities rather common; see e.g. TEYSMANN, l.c. *Fl.* Oct.-Dec., *fr.* Dec.-May.

Uses. An estimated timber tree, used for boats etc. (HEYNE, l.c.).

Vern. *Tuwé*, Atjeh, *tuhi*, Karo-Batak, *radja*, Batak, *sungkè* (*tjirit*), M., Padang Uplands, *sungkai rimbo*, Minangkabau. The name *sungkai* is also used in Palembang for another timber tree with opposite pinnate leaves: *Peronema canescens* (Verben.).

Note. DEN BERGER & BIANCHI (Tectona 24, 1931, 894-903) noted that the vessels contain a sulphur-yellow substance colouring red with alcohol: lapachol; a rare feature.

This tree is cultivated in Hort. Bog. *sub n.* XI-C-106A and XI-H-27; unfortunately duplicates of several other numbers (XI-I-10, 20 & 50) have been distributed under this name also; they, however, all belong to *Dolichandrone serrulata* (WALL. ex DC.) SEEM.

11. LAMIODENDRON

STEEN. Nova Guinea n.s. 8 (2) (1957) 381, f. 1. — Fig. 26.

Evergreen tree. Twigs thick, hard, lenticellate, nodes with pitted glands, internodes flattened. *Leaves* 1-pinnate; leaflets without domatia. *Racemes* or *panicles* terminal or from the twigs, hairy and with numerous capitate-glandular hairs. *Thyrses* terminal, sometimes reduced to short-racemiform. *Flowers* large, not articulated with the pedicels. Pedicels bracteolate, often with abortive flowers in the axil. *Calyx* halfway split, valvately 5-lobed already in bud, thin, veined. *Corolla* campanulate, hardly zygomorphic, without basal tube, glabrous, glandular-punctate; lobes 5, imbricate in bud, rounded, entire. *Stamens* 4 and a staminode, inserted in the hairy throat. *Ovary* 4-sulcate, each cell with 2 placentas on the septum, ovules very many, in many rows; stigma with 2 oblong-spathulate lips. *Capsule* (immature, $4\frac{1}{2}$ cm long) linear, shortly beaked, oval in CS with a flat septum on which developed winged ovules; pericarp with 2 fine grooves in the middle of the valves and obviously the capsule loculicid.

Distr. Monotypic. *Malesia*: E. New Guinea: Milne Bay Distr., d'Entrecasteaux Is. (Normanby I.) and Louisiades (Rossel I.).

Ecol. Coastal lowland forest, rain-forest and sago swamps.

Taxon. Possibly related to *Fernandoa*, but lacking domatia and with small crateriform glands on the leaflets beneath; the fruit structure may yield further criteria.

1. *Lamiodendron magnificum* STEEN. Nova Guinea n.s. 8 (2) (1957) 381, f. 1; Blumea 18 (1970) 563. — Fig. 26.

Tree, 12-20 m; flush purplish green. *Leaves* 4-5-jugate, glabrous, 30-50 cm; petiole ($2\frac{1}{2}$ -)6-10 cm; petiolules 1-2 cm; leaflets firmly chartaceous, ovate-oblong, acuminate, oblique with unequal base, 7-19 by $3\frac{1}{2}$ -9 cm; nerves 7-11 pairs; beneath with scattered, small, pitted crateriform glands. *Thyrses* glandular-hairy, 2-3 times cymosely branched, up to 18 cm, sometimes seemingly from old wood reduced to racemiform and rachis 1-3 cm. Bracts ovate-acute, 3-4 mm. Pedicels $1\frac{1}{2}$ - $2\frac{1}{2}$ cm, with 1-2 pairs of bracteoles 3-5 mm long. *Calyx* 2-3 cm, with a few glands, rather densely short capitate-glandular hairy; lobes wide-ovate, mucronate, 1- $1\frac{1}{2}$ by $\frac{3}{4}$ -1 cm. *Corolla* showy, brilliant orange to apricot, dark purple-red veined, with many small glands and the lobes (and tube) laxly capitate-glandular hairy, 8-10 by $4\frac{1}{2}$ -6 cm; lobes $\frac{1}{2}$ -2 cm long, 3- $3\frac{1}{2}$ cm wide. *Stamens* 5-7 cm long, inserted near the base

of the corolla, at the base densely hairy; staminode 2 cm; anthers with free, divaricate cells, not versatile, reflexed, 6 mm long. *Ovary* quadrangular-fusiform, 1 cm long, with large impressed glands, moreover covered by dense, microscopical 1-celled hairs and short-stalked peltate to capitate-glandular hairs; style 4-6 cm; stigmatic lobes oblong-acuminate, 4 mm.

Distr. *Malesia*: E. New Guinea (Milne Bay Distr., Raba Raba Subdistr., Biniguni, May I track, 9°38' S, 149°18' E; Northern Distr., Popondetta Subdistr., road to Gona-Arunda; near Wanigela; near Alotau), Normanby and Rossel Is.

Ecol. In Normanby I. forming a community on a gravel bank behind the beach fronting swamp forest, near Wanigela in sago swamps, in Rossel I. at 10 m in a rain-forest on a stream bank, near Biniguni in poor lowland rain-forest at 90 m, in Popondetta in disturbed forest, near Alotau CRUTTWELL saw a single tree.

Note. Worthy of introduction into cultivation for the large showy flowers.

Glabrous tree without buttresses, robust in all its parts. *Leaves* 1-pinnate; rachis and petiole sharp-keeled above. *Thyrse*s coarse, erect, terminal; branches scattered, 1-3 times dichotomous. *Calyx* closed in bud, campanulate, coriaceous, with 5 irregular lobes, articulated with the pedicel. *Corolla* large, ventricose-campanulate,

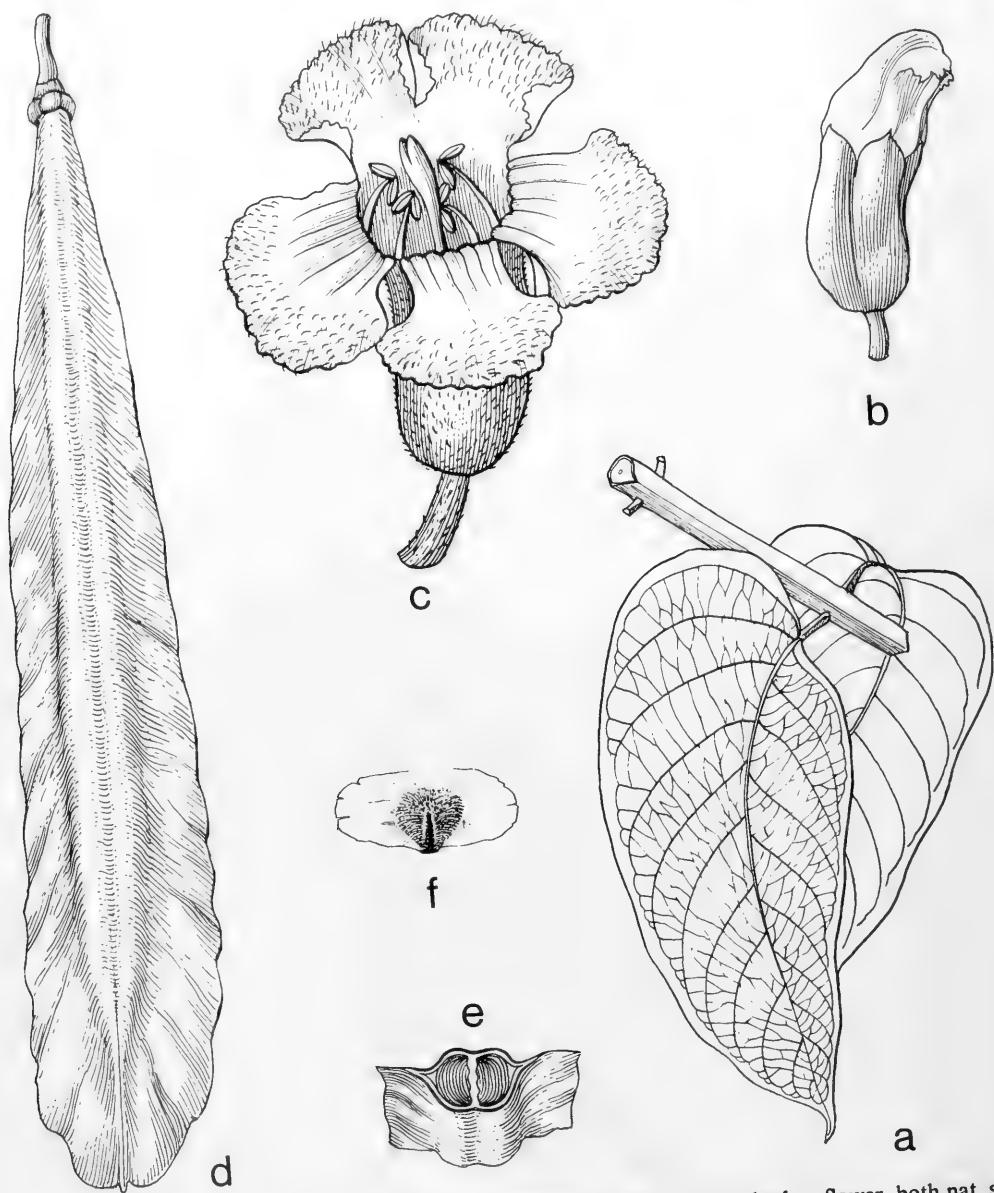


Fig. 27. *Pajanelia longifolia* (WILLD.) K. SCH. a. Fragment of leaf, $\times \frac{1}{2}$, b. bud, c. flower, both nat. size, d. capsule, e. ditto in CS, both $\times \frac{1}{2}$, f. seed, nat. size (a-c after WALLICH, Pl. As. Rar. 1, t. 95/96, e-f KERR 18547).

± constricted above basal tube, zygomorphous; lobes 5, spreading to recurved, nearly equal, 2 lobes connate halfway up, imbricate in bud. *Stamens* 4, inserted at apex of lower tube, didynamous, subexserted, 5th rudimentary; filaments thick, anther-cells divergent. *Disk* large, annular, fleshy. *Ovary* oblong-cylindric; ovules in each cell ∞, on 2 placentas, ∞-seriate. *Capsule* flat, obovate-lanceolate, tipped, valves broadly winged along the margin. *Seeds* in several rows on the edges of the septum, compressed, hyaline-winged.

Distr. Monotypic, from Malabar eastwards through SE. Asia (E. Bengal: Khasia, Sylhet; Burma: Pegu, Travancore, Chittagong, Tenasserim; Thailand, Andaman Is.) to *West Malesia*: N. Sumatra (E. Atjeh), Malaya (Perak, N. Kedah, ?Singapore, ?Penang), and the Natuna Is. (Sedanau, Bunguran, Duperré) in the S. China Sea, NW. of Sarawak. Fig. 28.

F.-VILLAR (Nov. App. 1880, 150) recorded it erroneously from the Philippines.

Ecol. Lowland evergreen mixed forests, in the Andaman Is. also in deciduous forest.

I assume bats visit the probably nocturnal flowers, but there are no direct records.

1. *Pajanelia longifolia* (WILLD.) K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1895) 244; STEEN. Bull. Jard. Bot. Btzig III, 10 (1928) 267; *ibid.* 12 (1932) 164, f. 2 (map). — *Pajaneli* RHEDE, Hort. Mal. 1 (1678) 79, t. 44, *sphalma in textu* t. "45". — *Bignonia indica* var. β LINNÉ, Sp. Pl. (1753) 625. — *Bignonia longifolia* WILLD. Sp. Pl. 3 (1800) 306. — *Bignonia pajanelia* BUCH. HAM. Trans. Linn. Soc. 13 (1821) 516, *nom illeg.*, quoting WILLD. — *Bignonia multijuga* WALL. [Cat. 6503] Pl. As. Rar. 1 (1830) 81, t. 95-96; G. DON, Gen. Syst. 4 (1838) 221. — *P. multijuga* A.P.DC. Bibl. Univ. Genève II, 17 (1838) 130; A.DC. Prod. 9 (1845) 227, *excl. syn.* LOUR. *et* PERS.; MIQ. Fl. Ind. Bat. 2 (1858) 758; BUREAU, Mon. (1864) 50, t. 20; KURZ, Prel. Rep. For. Veget. Pegu (1875) App. A: xciii, App. B: 69; Fl. Burma 2 (1877) 237 ('*Payanelia*'); GAMBLE, J. As. Soc. Beng. 74, ii (1905) 382; RIDL. Fl. Mal. Pen. 2 (1923) 549. — *P. rheedii* WIGHT, Ic. 4 (1848) t. 1343-4; Ill. 2 (1850) t. 161bis; BEDD. Fl. Sylv. 3 (1872) clxix, t. 21-5; CLARKE, Fl. Br. Ind. 4 (1884) 384; BRANDIS, Ind. Trees (1906) 494; PARKINSON, For. Fl. Andam. (1923) 215. — *P. bijuga, lapsus mihi*, in *syn.* Bull. Jard. Bot. Btzig III, 10 (1928) 267. — Fig. 27, 29.

Evergreen, small to large tree up to 30 m, 1 m Ø, changing leaves before flowering. Innovations resinous. Twigs terete, thick, lenticellate. *Leaves* 1-pinnate, 8-12-jugate, 40-120 cm; petiole thick, to 15 cm, rachis sharply keeled above, rounded beneath; leaflets entire, oblique, ovate-oblong, tipped, chartaceous, 10-20 by 5-8 cm, 3-5 mm stalked; nerves anterior side 9-12, posterior 6-9 pairs; beneath with scattered or heaped crateriform glands along the midrib. *Thyraxes* up to 1 m, coarse, rachis hollow, 1 cm Ø; pedicels 2½ cm; bracteoles minute. *Flowers* with a soapy smell, pale yellowish, inside dull-purple shaded. *Calyx* 3-5 cm, densely covered with microscopical glands and besides with scattered, rimmed, dish-shaped, large glands; splitting into 5 irregular, crispately-crenulate, acute lobes, tube at base with keel-like folds, persistent. *Corolla* 5-7½ cm, thick, ± constricted above base, pubescent except at base; lobes imbricate in bud, in anthesis reflexed, broad-obovate, crenulate and crispate; anthers brown to nigrescent, cells divergent. *Style* long, with a 2-lobed, clavate stigma. *Capsule* stiped,

30-45 by 5-9 cm (incl. the 2-3 cm wide, often splitting wings), with a dorsal ridge, and a corky margin on which the wings; septum quadrangular in CS, contracted in the middle, corky. *Seeds* in ∞ rows on each margin of the septum, curved, 2¼-3 by ¾-1¼ cm (incl. the hyaline wings).

Distr. As the genus. Erroneously recorded for the Philippines by F.-VILLAR, Nov. App. (1880) 150. Rarely planted (Atjeh). Fig. 28.

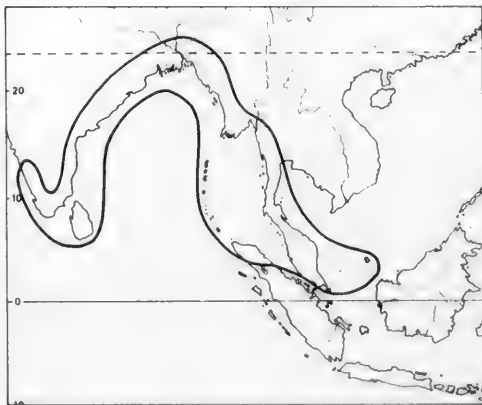


Fig. 28. Range of the genus *Pajanelia* A.P.DC.

Ecol. Lowland primary and secondary rain-forest, in the Natuna Is. common, with plenty of seedlings, spared in coconut stands, elsewhere scattered, riverbanks, etc., mostly coastal, from sea-level to 100 m; in the Ghats recorded to 700 m altitude. *Fl.* Jan.-April, Aug., fr. March-April, Aug.

Indian authors cite it as being evergreen, but in the Natuna Is. I found it shortly deciduous. KURZ found it in Burma an evergreen tree. He recorded it from the Andaman Is. as 'very abundant in the leafless jungles', that is: monsoon forest (Rep. Veg. Andam. Is. 1870, 12, 43, 71). PARKINSON gave no definite clue on the leaf change.



Fig. 29. Tree of *Pajanelia longifolia* (WILLD.) K.SCH. showing the sparingly branched, \pm pachycaul habit; behind is a limestone hill with dry evergreen forest (photogr. CORNER, 1935, Sg. Sedili).

The calyx contains water in bud, like other coarse-flowered members (*Spathodea*, *Oroxylum*, etc.).

Uses. GAMBLE (Manual Ind. Timb. ed. 1922, 517) said it is a good timber with close-grained wood. PARKINSON *l.c.* found it common in the Andaman Is. where it is used for canoes, planking, and boat-building; timber smells like teak and seems to withstand attacks of white ants. KURZ (1870) recorded the largest tree with a trunk of 2 m \varnothing . In the Natuna Is. it is estimated for building boats.

In the latter islands a decoction of leaves is used against fever; in Malaya a hot fermentation is applied on the body for stomach disorders (BURKILL, Dict. 1935, 1623).

Vern. *Békak gunong*, *bongli*, *kaju bonglai*, M, Malaya, *kaju sémua*, Natuna Is., *abeuèng laut*, Meulaboh, Atjeh.

Note. For obscure reasons BEDDOME (*l.c.*) found this anomalous in the family, its flower reminded of *Jasmineae*; but he also included *Schrebera* (*Oleaceae*)!

13. NEOSEPICAEA

DIELS, Bot. Jahrb. 57 (1922) 500, f. 1; STEEN. Thesis (1927) 899; Bull. Jard. Bot. Btztg III, 10 (1928) 216; Nova Guinea n.s. 8 (1957) 173; *ibid.* Bot. n. 3 (1960) 15. — *Hausmannia* F.v.M. Fragm. 4 (1864) 148, non *Hausmannia* DUNKER, 1846; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 223; STEEN. Thesis (1927) 901. — *Nyctocalos* subg. *Hausmannia* SEEM. J. Bot. 8 (1870) 149. — *Pandorea* sect. *Leptophyllae* STEEN. Thesis (1927), 841, in *clav.*; Bull. Jard. Bot. Btztg III, 10 (1928) 200. — *Pandorea* sect. *Grandiflores* STEEN. Nova Guinea 14 (1927) 301, in *clav.*, *pro parte*. — *Tecomanthe* sect. *Aurantiacae* STEEN. Thesis (1927) 872, in *clav.*; Bull. Jard. Bot. Btztg III, 10 (1928) 203. — *Hausmannianthes* STEEN. Proc. R. Soc. Queensl. 41 (1929) 50. — Fig. 30, 37c.

Large lianas. Twigs with a distinct gland-field on the nodes. *Leaves* digitately compound; leaflets 3–5, sessile or short-stalked, only articulated at the base of the petiolule, mostly unequal, terminal one largest, often with a metallic hue above (*s.s.*), both faces with numerous microscopical glandlets, underneath besides with

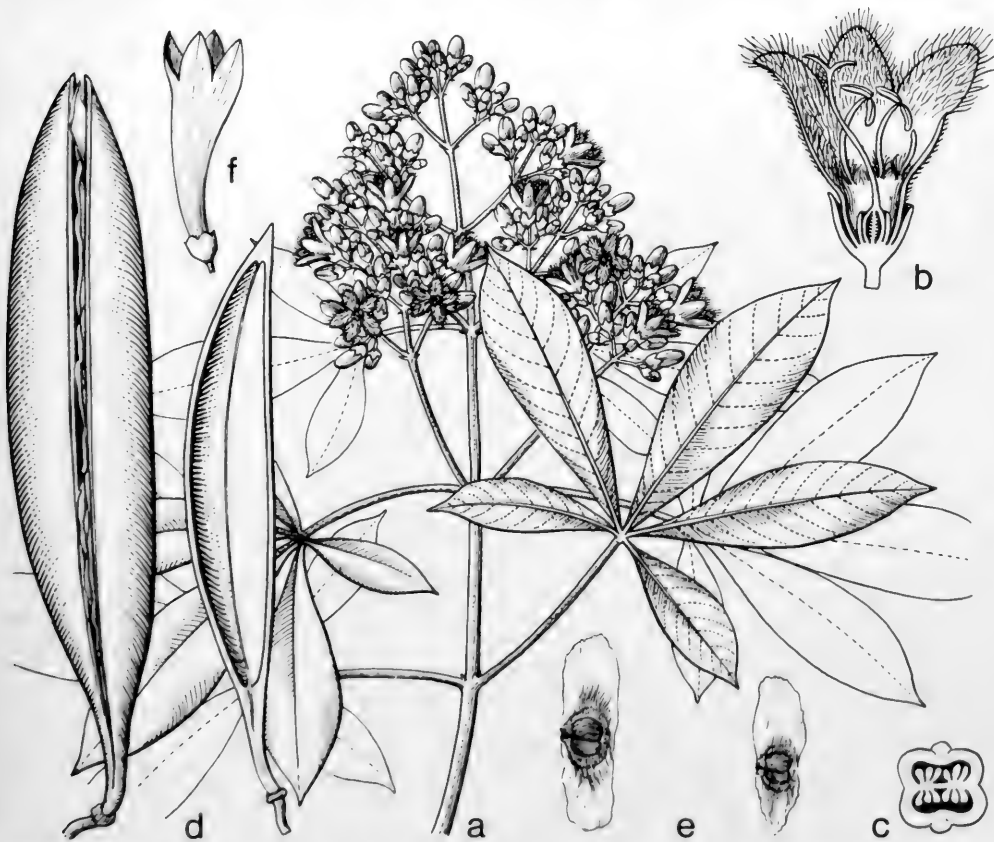


Fig. 30. *Neosepicaea viticoides* DIELS. a. Habit, $\times \frac{1}{2}$, b. LS of flower, showing also disk and staminode, $\times 2$, c. CS of ovary, $\times 12$. — *N. leptophylla* (BL.) STEEN. d. Just opened capsule and one valve from inside, $\times \frac{1}{2}$, e. two seeds, $\times \frac{1}{2}$, f. flower, $\times \frac{1}{2}$ (a–c LEDERMANN 9809, after DIELS, d–e BECCARI PP 687, f D. BERGMANN 261).

few, flat, scattered, larger, round glands $\frac{1}{4}$ – $\frac{1}{2}$ mm \varnothing . *Thyrses* ∞ -flowered, terminal, axillary to ramiflorous. *Calyx* proportionally small, cupular to campanulate, truncate and minutely toothed, or shallowly 5-lobed by tearing. *Corolla* short-campanulate or more often \pm curved, narrow trumpet-shaped, glabrous, or outside at least the lobes puberulous-papillose; lobes deltoid, valvate, tomentose on the inner margin, lobes or tube inside sometimes with larger hairs; tube with a dense ring of long hairs at the insertion of the stamens. *Stamens* 4, didynamous, exserted, 5th rudimentary; anther-cells divaricate. *Disk* cupular, enveloping the ovary base. *Ovary* glabrous; style exserted; stigma 2-lamellate, 2-celled, with 2 placentas in each cell and ∞ ovules. *Capsules* stipitate, c. 10–20 cm long, narrow oblong, terete to broad-ellipsoid in section, beaked; valves boat-shaped. *Seeds* ∞ , thin-winged, rectangular.

Distr. Queensland (1 sp.) and *Malesia*: New Guinea (3 spp.). Fig. 31.

Ecol. Rain-forests, from the lowland up to c. 2000 m.

Note. In the *Campsis*-alliance possibly closest related to *Pandorea*, different by the almost regular flowers, the valvate corolla lobes, the exserted stamens and style, digitate leaves, and cupular disk clasping the base of the ovary.

KEY TO THE SPECIES

1. Corolla brown, basal tube, upper tube and lobes all about $\frac{1}{2}$ cm long; lobes inside bearded, tube on one side so 1. *N. viticoides*
1. Corolla red or orange, at least 3 cm long, the tube many times as long as the lobes.
2. Corolla orange, 10 cm long incl. the lobes 3. *N. aurantiaca*
2. Corolla red or pink, $2\frac{1}{2}$ –7 cm long incl. the lobes.
3. Corolla 5–7 cm long, puberulous to glabrous, lobes 1–2 cm long, outside sometimes with dark glands, inside sometimes long-hairy. *Thyrses* axillary. Capsule 13–20 by 3 cm, with woody valves. Seeds (incl. wings) 5 by $1\frac{1}{2}$ cm 2. *N. leptophylla*
3. Corolla $2\frac{1}{2}$ –3 cm long, glabrous outside except occasionally the puberulous apex of the glandless lobes $\frac{1}{2}$ cm long, inside glabrous. *Thyrses* terminal and from the uppermost leaf-axils. Capsule 10–15 by $2\frac{1}{2}$ cm, the valves thin-coriaceous. Seeds (incl. wings) 3 by 1 cm. Queensland. Cf. STEEN. Nova Guinea n.s. 8 (1957) 174 *N. jucunda* (F.v.M.) STEEN.

1. *Neosepicaceae viticoides* DIELS, Bot. Jahrb. 57 (1922) 500, f. 1; S. MOORE, J. Bot. 61 (1923) Suppl. 38; STEEN, Thesis (1927) 900; Bull. Jard. Bot. Btzg III, 10 (1928) 217; J. Arn. Arb. 28 (1947) 423; Nova Guinea n.s. 8 (1957) 174; *ibid.* Bot. n. 3 (1960) 15. — Fig. 30a–c.

High-climbing canopy liana. *Leaflets* (3–)4–5, oblong-elliptic, acuminate, chartaceous, often with a metallic hue above, sessile to $1\frac{1}{2}$ cm stalked by the tapering base; 8–17 by 3–7 $\frac{1}{2}$ cm; petiole 3–10 cm. *Thyrses* terminal and in uppermost leaf-axils, 5–20 cm long. Pedicels c. $\frac{1}{4}$ – $\frac{1}{2}$ cm. *Calyx* cupular, 3–5 by 3–5 mm, shallow-lobed, glandless. Mature *corolla* $2\frac{1}{2}$ –3 cm, outside papillose, basal tube about as long as the widened upper tube and as the lobes, brown, with dark streaks inside; lobes long-hairy within, 3–4 mm; tube with a long-hairy zone inside to the insertion of the stamens.

Distr. *Malesia*: East New Guinea (18 collections), in W. one.

Ecol. Rain-forest, not rare, from sea-level to c. 1500 m. Fl. Jan.–Oct.

Notes. A homogeneous species, but the flower colour is variously defined probably in part due to the age of the flowers: dull ochre, dull yellow with maroon markings, brownish olive, dull red or brick-purple, brown and purple within; petals velvet red. Young leaves are purple.

No fruit has as yet been collected, and it has only once been found in West New Guinea.

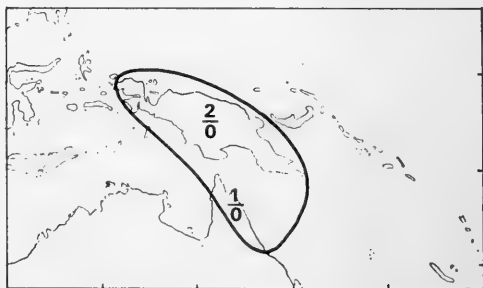


Fig. 31. Range of the genus *Neosepicaceae* DIELS; in New Guinea 2 (?) and in Queensland 1 endemic species.

2. *Neosepicaceae leptophylla* (BL.) STEEN. Nova Guinea, Bot. n. 3 (1960) 15. — *Tecoma leptophylla* BL. Rumphia 4 (1849) 35, *quoad flor.*; Mus. Bot. 1 (1849) 27; Miq. Fl. Ind. Bat. 2 (1858) 758; Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 197; K.Sch. in

K.Sch. & Laut. Fl. Schutzgeb. (1900) 540. — *Gelsemium leptophyllum* O.K. Rev. Gen. Pl. 2 (1891) 480. — *Pandorea leptophylla* BOERL. Handl. 2 (1899) 600; DIELS, Bot. Jahrb. 57 (1922) 449; STEEN. Nova Guinea 14 (1927) 301, t. 33; Thesis (1927) 843; Bull. Jard. Bot. Btztg III, 10 (1928) 200; Proc. R. Soc. Queensl. 41 (1929) 46, 56. — *N. superba* STEEN. Nova Guinea n.s. 86 (1957) 173; *ibid.* Bot. n. 3 (1960) 15. — Fig. 30d–f.

Large liana, up to 20 m, 3 cm Ø. Leaflets 3–5, oblong elliptic, acuminate, chartaceous to coriaceous, often with a metallic hue above, base cuneate in degree, from sessile to not rarely narrowed to a pseudo-petiolule to 3 cm long; 6–18 by 3–11 cm; petiole 5–12 cm. Thyrses obviously axillary, or on old wood, 5–30 cm long. Pedicels $\frac{1}{2}$ – $1\frac{1}{4}$ cm. Calyx cupular, not appressed to corolla, 4–7 by 6–7 mm, margin \pm entire to shallowly lobed, glabrous, often with a few glands. Mature corolla 5–7 cm (incl. the lobes c. 1–2 by $\frac{1}{2}$ – $\frac{3}{4}$ cm), tube $2\frac{1}{2}$ cm wide at mouth, slightly curved, outside glabrous or papillose (except at base), purplish (see notes), lobes outside papillose or glabrous, with few to several dark glands or glandless, inside sometimes with long hairs; tube inside glabrous or with a few or a line of long hairs. Capsule 13–20 by $2\frac{1}{2}$ cm, terete or oval in section, the valves woody. Seeds (incl. the wings) 4–5 by $1\frac{1}{2}$ cm.

Distr. *Malesia*: New Guinea.

Ecol. Rain-forest from the lowland to c. 2000 m. Fl. March–May, July–Nov.

Vern. *Ie-up*, Kebar (once noted).

Notes. Fruits have only once been collected by BECCARI (Arfak Mts).

All inflorescences hitherto observed are axillary, a single one is from old wood.

The flower colour seems to vary, and to change. VINK (BW 11404) noted buds: calyx green, tube pale green, lobes purple; submature flower base of tube yellow, further orange-red, inside yellow, orange-red veined. PULLEN (7729) noted on mature flowers: pale purple, lobes recurved, inside white with purple streaks. Others say merely flowers pale

violet; PLEYTE (887) noted yellow. As in *N. jucunda* the lobes obviously are reflexed in mature flowers.

I have reduced here *N. superba* which was distinguished by the papillose-puberulous corolla, dark glands on the outside of the lobes, and long hairs within extending in a narrow line into the tube. Three collections have this well expressed (BRASS 23829, PAYMANS 53 and PULLEN 7729). However, there are other specimens defeating these characters: SATAKE 834 and PLEYTE 887 have no hairs in the tube and hardly any glands on the lobes; BECCARI s.n. has a puberulous corolla, but no long hairs; BERGMANN 226 has an occasional hair in the tube and an occasional gland on the lobes, but a glabrous corolla; BERGMANN 261 has the long hairs inside, but a glabrous corolla without glands and thus comes nearest to BLUME's type.

The Papuan species is close to *N. jucunda* from Queensland. This has a much smaller, glabrous corolla except occasionally the puberulous tip of the lobes, the latter constantly much smaller; also the thyrses are generally terminal whereas they always seem lateral in *N. leptophylla*; its fruit is smaller and the valves much thinner.

3. *Neosepicaea aurantiaca* (DIELS) STEEN. Blumea 15 (1967) 298. — *Tecomanthe aurantiaca* DIELS, Bot. Jahrb. 57 (1922) 497; STEEN. Nova Guinea 14 (1927) 296; Thesis (1927) 874, 834, f. 3d; Bull. Jard. Bot. Btztg III, 10 (1928) 204. — Fig. 37c.

Leaflets 3, coriaceous; petiole 6–7 cm; blade oblong, acuminate, cuneate at base, 10–15 by $4\frac{1}{2}$ –6 cm; nerves 8–10 pairs. Thyrses axillary; peduncle 8 cm. Calyx 5–8 by 8–9 mm. Corolla orange, c. 10 cm long, $2\frac{1}{4}$ – $2\frac{3}{4}$ cm wide at apex; lobes inside puberulous, $1\frac{1}{2}$ – $2\frac{1}{2}$ cm.

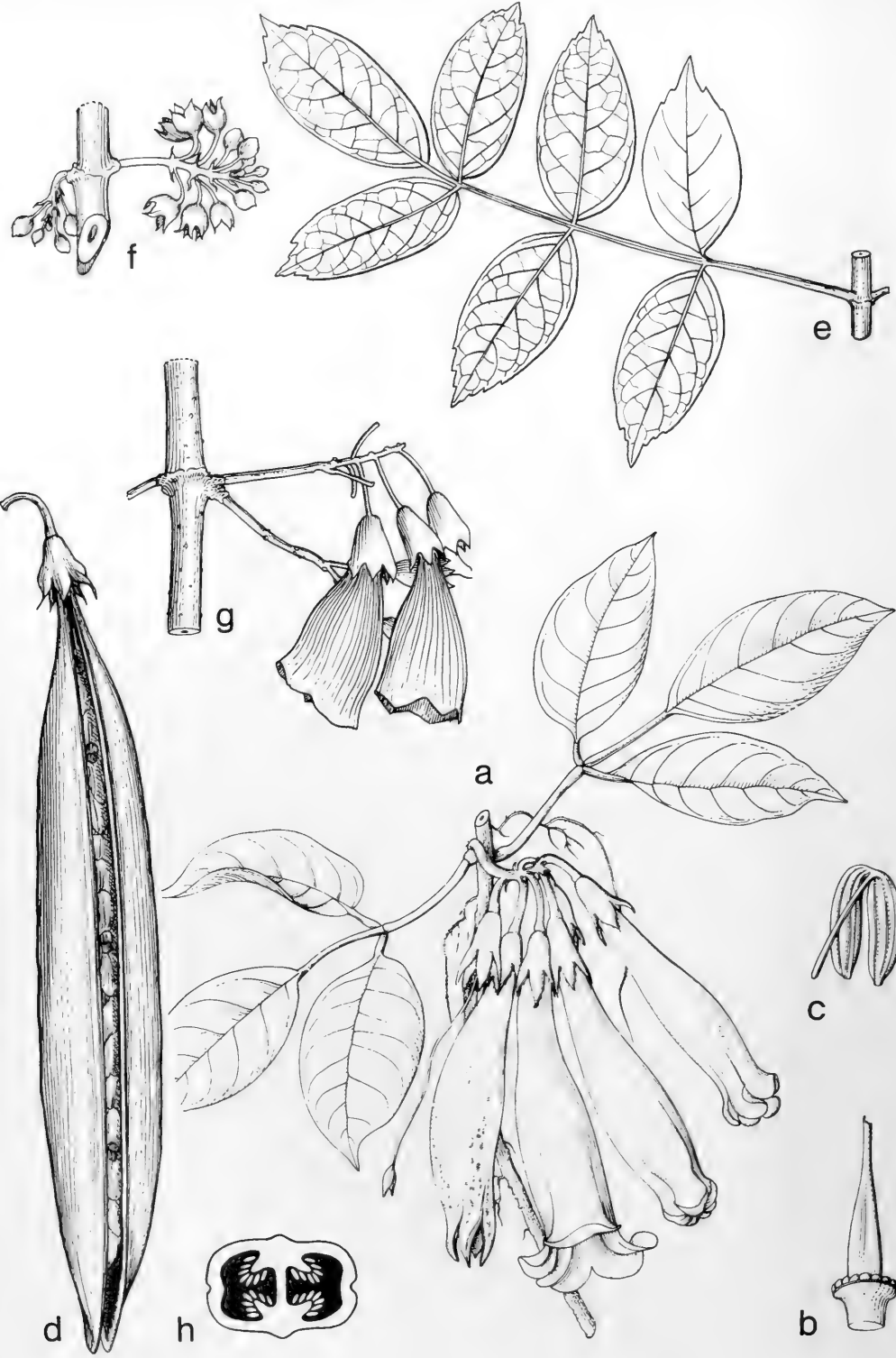
Distr. *Malesia*: East New Guinea (Etappenberg, Sepik Distr.: LEDERMANN 9561, B†), once found at 850 m.

Note. The cupular calyx and thyrsoïd inflorescence stamp this as a *Neosepicaea*. It might turn out to be an exceptionally large-flowered form of *N. leptophylla*.

14. TECOMANTHE

BAILL. Hist. Pl. 10 (1891) 41; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230; BOERL. Handl. 2 (1899) 590; DIELS, Bot. Jahrb. 57 (1922) 496; STEEN. Nova Guinea 14 (1927) 294; Thesis (1927) 864; Bull. Jard. Bot. Btztg III, 10 (1928) 201, incl. sect. *Dendrophilae*, *Volubiles* et *Saxosae* STEEN. l.c. 205, 208, 210; Pac. Pl. Areas 1 (1963) 288, map. — *Campana* RUMPH. ex POST & O.K. Lexicon (1904) 95, nom. inval. — *Pandorea* sect. *Grandiflores* STEEN. Nova Guinea 14 (1927) 301, *pro parte*. — Fig. 32–36.

Small to large lianas, climbing or creeping (in mountain heaths). Glands on twig-nodes small. Leaves 1-pinnate, 1–7-jugate; leaflets entire or toothed, underneath very finely punctate-glandular. Racemes short, pendent, from efoliate nodes on old wood, very rarely axillary or terminal; peduncle short, with some crowded, small, sterile bracts at base, in fruit thickening like a brachyblast; rachis short (up to c. 7(–13) cm); flowers opposite, in the axil of a small, narrow fugacious bract.



Pedicels with 2 small, narrow bracteoles. *Calyx* closed in bud, persistent, *c.* $1\frac{1}{2}$ –4 cm, with 5 fairly large, deltoid \pm equal lobes short-hairy along the margin, rarely split on one side. *Corolla* infundibuliform, the basal tube gradually widening upwards, \pm straight, mostly pink, *c.* 5–12 cm long, inside near the insertion of the stamens stuppous or lax-hairy and sometimes with capitate-glandular papillae; limb mostly slightly zygomorphous, very rarely distinctly zygomorphous; lobes in bud narrowly imbricate, mostly deltoid. *Stamens* didynamous, mostly included, 5th rudimentary; anther-cells almost free, (in Mal.) *c.* 4 mm and almost always divaricate. *Disk* thick, annular. *Ovary* glabrous, in each of the 2 cells with ∞ rows of ovules attached on 2 placentas on the dissepiment; stigma long, filiform, with 2 spathulate stigmas. *Capsule* linear-terete or flattened, stipitate and beaked, with 2 coriaceous or almost woody, smooth, wide or very narrow boat-shaped valves. *Seeds* ∞ , orbicular, with fairly large, thin-membranous wings.

Distr. Species 5, 1 in the Three Kings Is. at the N. tip of New Zealand, 1 in East Queensland, the others in *Malesia*: Moluccas (Ternate, Halmaheira, Ambon, Ceram, Aru Is.), throughout New Guinea (incl. Misool, Biak, Jappen, New Britain and Woodlark I., Trobriands), and ?Solomons (Bougainville). Fig. 34. Ecol. Primary and secondary rain-forest, mossy forest and mountain heaths, from sea-level up to 3100 m.

One collector noted honey in the flowers. It is likely that the diurnal flowers are bird-pollinated, but there are no records.

Tecomanthe speciosa was derived from cuttings of the single plant found in nature. It has in cultivation produced flowers and can obviously propagate by self-pollination. The corolla is sometimes (in the herbarium) already \pm open before full maturity. In one case rather long, unbranched, pendent, aerial roots were observed emitted from a node. In juvenile specimens leaves tend to be more toothed than in mature foliage.

Taxon. As I stated before *Tecomanthe* belongs with *Pandorea* to a distinct circum-Pacific affinity of lianas, including *Campsis* in East Asia and North America and *Campsidium* in Chile, all sharing a similar shape of flower and fruit. The South African genus *Podranea* is more remote and with its inflated calyx and linear capsules possibly more allied to *Tecoma*. The four genera can be keyed out as follows:

1. Flowers in racemes, opposite. Evergreen, not climbing with roots. Calyx with well-developed lobes, 1–4 cm long. Corolla with a hair-ring (lax or stuppous, sometimes replaced in part by capitate-glandular papillae) near the insertion of the stamens.
2. Racemes almost always on the old wood, rarely axillary or terminal. Peduncle at the base with crowded sterile bracts, rachis up to 7 cm, pendent, flowers close together. Calyx large, $1\frac{1}{2}$ –4 cm. Corolla 6–12 cm, tube not contracted below the slightly or distinctly zygomorphous limb; lobes deltoid, in bud narrowly imbricate. Anthers mostly included, cells almost always divaricate. Valves of the capsule widely or narrowly boat-shaped; endocarp not removable *Tecomanthe*
2. Racemes terminal on leafy twigs. Peduncle at base without bracts; flower pairs spaced. Calyx *c.* 1 cm. Corolla *c.* $3\frac{1}{2}$ cm long, tube contracted below the limb; lobes rounded. Stamens \pm exserted; anther-cells free but parallel. Capsule narrowly elliptic-oblong, with removable papery endocarp. Chile *Campsidium*
1. Flowers paniculate in terminal thyrses, very rarely depauperate in racemes but then the calyx much smaller than 1 cm. Corolla lobes widely imbricating. Anther-cells divaricate.
3. Deciduous, climbing with roots. Leaflets 5 pairs, distinctly sharply serrate. Calyx large, *c.* $1\frac{1}{2}$ –3 cm, with large lobes. Corolla inside glabrous, large, *c.* $5\frac{1}{2}$ –8 cm *Campsis*
3. Evergreen, not climbing with roots, rarely erect (in arid country). Leaflets 1–7 pairs, not distinctly sharply serrate in mature specimens. Calyx small, stunted or short-lobed, $2\frac{1}{2}$ –8 mm. Corolla smaller, $1\frac{1}{2}$ – $3\frac{1}{2}$ (–5) cm, almost always with a hair-ring near the insertion of the stamens and long hairs one-sided in throat and upper part of tube *Pandorea*

Uses. Almost all species are ornamental and can be cultivated in tropical and subtropical countries; they are not hardy. Propagation by cuttings or seed.

KEY TO THE SPECIES AND SUBSPECIES

1. Corolla cream-coloured, woolly tomentose in the upper half, 6–8 cm long, the limb very zygomorphic. Stamens exserted, anthers *c.* 10 mm, with parallel cells. Calyx often split on one side to the base, the

Fig. 32. *Tecomanthe dendrophila* (BL.) K. SCH. a. Habit, $\times \frac{1}{2}$, b. pistil, c. anther, both enlarged, d. capsule, $\times \frac{1}{2}$. — *T. ternatensis* STEEN. e. Leaf, f–g. inflorescence in bud and flower, all $\times \frac{1}{2}$ h. CS of ovary (a–c after BLUME, d LAE 58656, e–h BEGUIN 1201).



Fig. 33. *Tecomanthe dendrophila* (BL.) K.SCH. in the mossy forest on Mt Cycloop, N. New Guinea, at 1200 m (photogr. VAN ROYEN).

- lobes very unequal. Leaflets 5, orbicular-elliptic, apex broadly rounded to slightly notched, 8–18 by 5–11 cm, fleshy, coriaceous when dry. Capsule terete, pointed at both ends, c. 16 by $2\frac{1}{2}$ cm; valves thick, almost woody. Seeds 3–4 by $1\frac{1}{2}$ cm (incl. wings). Cf. HUNTER, Rec. Auckl. Inst. Mus. 5 (1958) 41, pl. 6–7; HUNT, Bot. Mag. 179 (1972) t. 618. Three Kings Is. (New Zealand) **T. speciosa** OLIV.
1. Corolla at most puberulous in the upper half of the lobes, not very zygomorphic. Anther-cells 3–4 mm long, divaricate. Calyx never split on one side to the base, lobes equal or unequal. Leaflets acute to acuminate.
2. Uniseriate hairs near the insertion of the stamens very lax, few or almost absent. Rachis of raceme glabrous. Corolla $4\frac{1}{2}$ –7 cm long.
3. Leaflets in 3–4 pairs, c. $3\frac{1}{2}$ –6 by $1\frac{1}{2}$ –3 cm, about twice as long as wide, herbaceous, veins between the main nerves usually distinct; lower lateral petiolules 0–3 mm. Calyx c. $1\frac{1}{2}$ cm long (incl. lobes). Corolla whitish, later pink tinged, $4\frac{1}{2}$ –6 cm, the lobes 2–5 by 10–15 mm, with dark dots in transparent view. Stamens as long as the style, \pm exserted. No capitate-glandular papillae near the insertions of the stamens **2. T. ternatensis**
3. Leaflets in 2 pairs (4 or 5), c. 3– $8\frac{1}{2}$ by $1\frac{1}{4}$ –4 cm, at least twice as long as wide, often narrower, obviously rather fleshy, at base rounded to truncate, often oblique, veins between the 4–5 main nerves hardly visible; lower lateral petiolules 4–9 mm, longer than upper ones. Calyx $2\frac{1}{2}$ –3 cm long (incl. lobes). Corolla tube pale, limb pink to rosy-purplish, tube marked with purplish lines inside, $4\frac{1}{2}$ –7 cm, lobes ovate-triangular, $(\frac{3}{4})$ – $1\frac{1}{4}$ by $(\frac{3}{4})$ – $1\frac{1}{2}$ – $1\frac{3}{4}$ cm, without dark dots. Stamens \pm shorter than the style, not exserted. Near the insertions of the stamens mainly capitate-glandular papillae and no or few uniseriate hairs. Capsule $5\frac{1}{2}$ by 2 cm. Cf. C. T. WHITE, Queensl. Nat. 4 (1920) 100, f.; STEEN, Proc. R. Soc. Queensl. 41 (1929) 49. Queensland **T. hillii** (F.V.M.) STEEN.
2. Hairs near the insertion of the stamens in a stuppe ring. Corolla 6–13 cm. Rachis of inflorescence often puberulous.
4. Leaves 1–2-jugate; leaflets fairly large, averagely 5–10 by $2\frac{1}{2}$ –5 cm, mostly herbaceous, usually entire, occasionally with a few coarse teeth to apex; rachis not winged. Lateral pedicels 2–8 mm. Racemes finally rich-flowered (6–20), on the old wood of coarse lianas. Capsule broad-elliptic in section, c. 17–22(–30) cm long, c. 3 (– $3\frac{3}{4}$) cm wide and thick, the valves wide-boat-shaped, hard, almost woody. Seeds including wing $2\frac{1}{2}$ – $3\frac{1}{2}$ by $1\frac{1}{4}$ – $1\frac{1}{2}$ cm **1. T. dendrophila**
4. Leaves 2–7-jugate; leaflets small, averagely $1\frac{1}{2}$ –4(–8) by $\frac{1}{2}$ – $1\frac{3}{4}$ (– $3\frac{1}{2}$) cm, herbaceous to coriaceous, the margin almost always toothed; the sulcate rachis (very) narrow-winged; lateral pedicels 0–2 mm. Racemes pauciflorous (2–6), lateral or terminal, on small, slender lianas. Capsule flat and compressed, 8–14 cm long, the valves very much compressed-boat-shaped, coriaceous. Seeds including wings c. $1\frac{1}{2}$ –2 by 1 – $1\frac{1}{2}$ cm.
5. Leaves 3–6(–7)-jugate, 4-jugate leaves always present. Leaflets thick-coriaceous to chartaceous (or even herbaceous), elliptic with usually short, acute apex, brittle in the herbarium, the nerves and midrib usually impressed above, never strongly prominent. Calyx $1\frac{1}{2}$ –3 cm. Corolla 6–10 cm. Staminate usually less than 1 cm long **3. T. volubilis**
5. Leaves 2(–3)-jugate, 4- and more-jugate leaves absent. Leaf-apex acute to cuspidate. Staminate $1\frac{1}{2}$ –3 cm.
6. Leaflets coriaceous, tough when mature, not easily breakable, sharply toothed, with nerves and veins conspicuously prominent on both sides. Calyx ($1\frac{1}{4}$)–2– $3\frac{1}{2}$ cm. Corolla 7–12 cm. **3b. T. volubilis ssp. tenax**
6. Leaves coriaceous to herbaceous, brittle in the herbarium, toothed but not sharply so; midrib and veins flat or slightly sulcate above, somewhat prominent beneath. Calyx $1\frac{1}{2}$ – $2\frac{1}{2}$ cm. Corolla 6–8 cm **3a. T. volubilis ssp. silvicola**

1. Tecomanthe dendrophila (BL.) K.SCH. in K.Sch. & Laut. Fl. Schutzgeb. (1900) 539; RECH. Denkschr. K. Ak. Wiss. M.-N. Kl. Wien 89 (1913) 603; DIELS, Bot. Jahrb. 57 (1922) 496; STEEN, Nova Guinea 14 (1927) 297; Thesis (1927) 880; Bull. Jard. Bot. Btzg III, 10 (1928) 206; LAUT. Bot. Jahrb. 62 (1928) 292; LOTHIAN, J. R. Hort. Soc. 83 (1958) 295; SYKES, Stud. Cult. Pl. N.Z. 1 (1966) 43, f. 18; HERKLOTS, Fl. Trop. Clim. (1976) 73, f. 97. — *Campana rubra* RUMPH. Herb. Amb. (1755) Auct. 42; an *Pandorea*? MERR. Int. Rumph. Herb. Amb. (1917) 469. — *Tecoma dendrophila* BL. RUMPHIA 4 (1849) 35, et *Dendrophila trifoliata* BL. sub. t. 190; Mus. Bot. 1 (1849) 25; Miq. Fl. Ind. Bat. 2 (1858) 757; Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 197; K.SCH. Bot. Jahrb. 9 (1887) 218; Fl. Kais. Wilh. Land (1889) 123; WARB. Bot. Jahrb. 13 (1891) 418; F.V.M. Descr. Not. 9 (1890) 64. — *Tecoma amboinensis* BL. RUMPHIA 4 (1849) 35; Mus. Bot. 1 (1849) 26; Miq. Fl. Ind. Bat. 2 (1858) 757. — *Campsis dendrophila* SEEM. J. Bot. 5 (1867)

373. — *Campsis amboinensis* SEEM. l.c. 374. — *T. bureavii* BAILL. Hist. Pl. 10 (1891) 41; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230. — *Gelseminum amboinense et dendrophilum* O.K. Rev. Gen. Pl. 2 (1891) 479. — *Pandorea dendrophila* BOERL. Handl. 2 (1899) 600. — *Pandorea amboinensis* BOERL. l.c. — *T. gloriosa* S. MOORE, J. Bot. 61 (1923) Suppl. 38; STEEN, Nova Guinea 14 (1927) 299; Thesis (1927) 888; Bull. Jard. Bot. Btzg III, 10 (1928) 210. — *T. venusta* S. MOORE, J. Bot. 61 (1923) Suppl. 38; STEEN, Nova Guinea 14 (1927) 298; Thesis (1927) 897, f. 5b, incl. var. *parviflora* STEEN.; Bull. Jard. Bot. Btzg III, 10 (1928) 216; HUNT, Bot. Mag. 180 (1975) t. 693; HERKLOTS, Fl. Trop. Clim. (1976) 71, f. 96, col. pl. 7. — *T. elliptica* STEEN. Nova Guinea 14 (1927) 296, t. 34D; Thesis (1927) 876, f. 5a; Bull. Jard. Bot. Btzg III, 10 (1928) 205. — *T. acutifolia* STEEN. Nova Guinea 14 (1927) 297; Thesis (1927) 879; Bull. Jard. Bot. Btzg III, 10 (1928) 206. — *T. amboinensis* STEEN. Nova Guinea 14 (1927) 298; Thesis (1927) 890;

Bull. Jard. Bot. Botz III, 10 (1928) 211. — *T. gjellerupii* STEEN. Nova Guinea 14 (1927) 298; Thesis (1927) 896; Bull. Jard. Bot. Botz III, 10 (1928) 215. — Fig. 32a-d, 33.

A tall liana, up to 20(–30) m. *Leaves* 1–2-jugate; leaflets ovate to elliptic or oblong-lanceolate, herbaceous to chartaceous, entire or with a few coarse teeth to the top, apex rather blunt to acuminate, (3–)5–13 by $(1\frac{1}{2}\text{--})2\frac{1}{2}\text{--}7$ cm; nerves flat above or slightly impressed, prominent beneath; rachis not winged; lateral petiolules 2–8 mm. *Racemes* on the old wood, the rachis c. $\frac{1}{2}\text{--}7$ (–13) cm, with usually 6–20 densely set flowers; pedicels 1–2 cm. *Calyx* herbaceous to \pm coriaceous, $(1\frac{1}{4}\text{--})1\frac{1}{2}\text{--}4$ cm long, for $\frac{1}{4}\text{--}\frac{1}{2}$ incised, greenish tinged red to purple-brown, the lobes triangular, blunt to cuspidate, 8–15 by 5–10 mm, midrib prominent or not. *Corolla* 7–11 cm long including the broad triangular acutish to blunt lobes $\frac{3}{4}\text{--}1\frac{1}{2}$ by 1–2 cm, the tube pink, rosa or pale carmine, the lobes creamy to yellowish, sometimes streaked with purple lines, or pink all over, inside near the insertion of the stamens stipose-hairy. *Anthers* c. 4 mm long, divaricate. *Capsule* almost cylindrical, stiped and beaked, 17–22(–30) by $3\text{--}3\frac{3}{4}$ by 3 cm, with hard, almost woody, boat-shaped valves. *Seeds* including the thin wing $2\frac{1}{2}\text{--}3\frac{1}{2}$ by $1\frac{1}{4}\text{--}1\frac{1}{2}$ cm.

Distr. *Malesia*: Moluccas (Ambon, Ceram, Aru Is.), New Guinea (throughout, and incl. Misool, Jappen, Biak, Woodlark I. & New Britain), and ?Solomons (Bougainville), 120 collections.

MILLAR & VANDENBERG collected this species (NGF 48505) at Arawa Plantation, Kieta Sub-distr., Bougainville, cultivated in a garden 'from a native vine'. I feel not certain that it is native in Bougainville; it might have been introduced from Papua.

Ecol. In swampy or dry rain-forests, sometimes riverine forest, once on limestone, from sea-level up to c. 1500 m. *Fl.* April–Dec., *fr.* June–Nov.

Vern. *Asee*, Maibrat lang., *fiyo*, Wapi lang., Marok; Sepik: *gwimbipuk*, *gwoimbipok*, Waskuk, *sanie*, Ambuti, *ilei*, Wagu, *yakomenga*, Narak & Ganja, Mt Hagen.

Notes. Through the great increase in collections it has appeared impossible to maintain several formerly described species. The characters of the leaves, calyx and corolla show transient, not correlated variation. Though the number of herbarium collections in which 1- and 2-jugate leaves occur together is restricted, they do occur on one plant in cultivation and in the forest according to collectors. The calyx shows a great variation in size and degree of incision. Puberulous hairiness may occur on the rachis, pedicels, the calyx, the midrib and nerves beneath, the apical part of the corolla-lobes, and on the leaf-rachis. Aberrations are sometimes found in individual specimens: a multi-lobed, wide calyx in BW 11242; a very thin, tortuous, 20 cm long rachis of a lax raceme in NGF 11866 and BW 13352; once a leaf with 6 and 7 leaflets; once long unbranched roots produced from a node of the old wood (JANOWSKI 427); an axillary raceme (BRASS 28745).

Seemingly open flowers measure sometimes only 5 cm, but I assume this to be caused in drying of immature flowers and tardy growth.

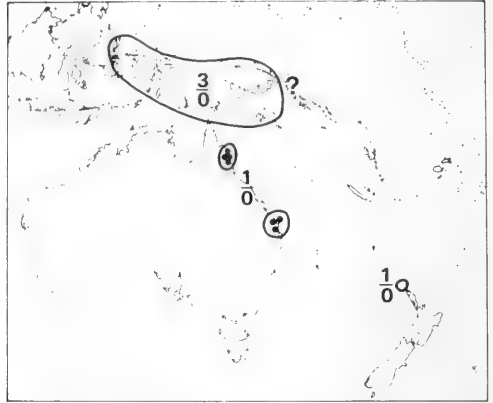


Fig. 34. Range of the genus *Tecomanthe* BAILL. Figures above the hyphen indicate endemic species, those below the hyphen non-endemic species. The Australian *T. hillii* (F.v.M.) STEEN. occupies two areas.

2. *Tecomanthe ternatensis* STEEN. Thesis (1927) 893; Bull. Jard. Bot. Botz III, 10 (1928) 214, f. 1. — Fig. 32e-h.

Large liana, up to 30 m or more; stem to arm-thick. *Leaves* 3–4-jugate; leaflets elliptic, herbaceous, base \pm rounded, apex short-acute, with some teeth towards the apex, c. $3\frac{1}{2}\text{--}7$ by $1\frac{1}{2}\text{--}3$ cm; veins between the nerves usually distinct; lower lateral petiolules 0–3 mm. *Racemes* on the old wood, 2–6 cm long, densely rich-flowered. Pedicels c. 1 cm. *Calyx* pale green, $1\frac{1}{2}\text{--}2$ cm long, the lobes deltoid, 7 by 5 mm. *Corolla* whitish, later tinged pink, 5–6 cm long including lobes, lobes wide and short, c. 2–5 by 10–15 mm, with dark spots in transparent view; tube near the insertions of the stamens with very few hairs and no capitate-glandular papillae. *Stamens* as long as the style, \pm exerted.

Distr. *Malesia*: Moluccas (Ternate, Halmaheira) and NW. New Guinea (Biak I.), 5 collections.

Ecol. Primary and secondary forest, in Biak on coralline limestone, in the Moluccas at 500–600 m. *Fl.* Sept.–Nov., April.

Note. The Biak specimens are rather poor but clearly belong to this species.

3. *Tecomanthe volubilis* GIBBS, Arfak (1917) 179; DIELS, Bot. Jahrb. 57 (1922) 498; STEEN. Nova Guinea 14 (1927) 299; Thesis (1927) 885; Bull. Jard. Bot. Botz III, 10 (1928) 209. — *T. nitida* STEEN. Nova Guinea 14 (1927) 299, t. 33; Thesis (1927) 887; Bull. Jard. Bot. Botz III, 10 (1928) 209. — *T. arfaki* STEEN. Nova Guinea 14 (1927) 300, t. 34B; Thesis (1927) 884, f. 5d, j; Bull. Jard. Bot. Botz III, 10 (1928) 208. — Fig. 35a-c.

Small, slender climber, 2–5 m. *Leaves* 3–6(–7)-jugate, with 4-jugate leaves always present; leaflets mostly glossy on both sides, dark green above, pale beneath, mostly coriaceous, brittle in the herbarium, ovate, obovate to elliptic, rarely lanceolate, base usually cuneate, apex acute, rarely blunt, margin in exposed places recurved, usually

with 1-5 pairs of bluntish teeth, $\frac{3}{4}$ - $2\frac{1}{2}$ by $\frac{1}{2}$ - $1\frac{1}{2}$ cm, usually sessile but lateral pedicels up to 2 mm, nerves above usually impressed, beneath usually prominent, often nigrescent in sicco. *Racemes* axillary or terminal, rachis $\frac{1}{2}$ - $2\frac{1}{2}$ cm; flowers 1-3 pairs, pedicels $\frac{3}{4}$ - $1\frac{1}{4}$ cm, both often

lax-puberulous. *Calyx* green suffused with red, coriaceous to herbaceous, $1\frac{1}{2}$ -3 cm, tube as long as or up to 2 times as long as the acute triangular lobes. *Corolla* pink to carmine, inside creamy, sometimes streaked red inside, 6-8(-10) cm including the triangular, acute lobes $1\frac{1}{2}$ - $2\frac{1}{2}$ by $1\frac{1}{2}$ -3 cm. *Staminode* usually less than 1 cm. *Capsule* 11-14 by 3-4 cm, compressed; valves coriaceous. *Seeds* c. $1\frac{1}{2}$ cm \varnothing .

Distr. Malesia: New Guinea (Mts Arfak, incl. Nettoti, Tamrau; Wissel Lakes, Wichmann, Carstensz, Lake Habbema, Star Mts, Telefomin, Bosavi), 20 collections.

Ecol. Mossy thickets and heaths, often burned, ridges in high forest, open scrub and secondary forest, sometimes on peaty soil or on limestone, 1250-3100 m. *Fl.* Sept.-Febr. (once April), *fr.* Aug., Nov., Jan., April.

Vern. Basengga, Hattam lang., Arfak, *daibuda*, *dëbëbuda*, Kapauku lang., Wissel Lakes.

Note. At lower altitude and more shaded localities leaflets tend to be larger and less rigid and coriaceous, with less impressed nerves above and flat leaf margin.

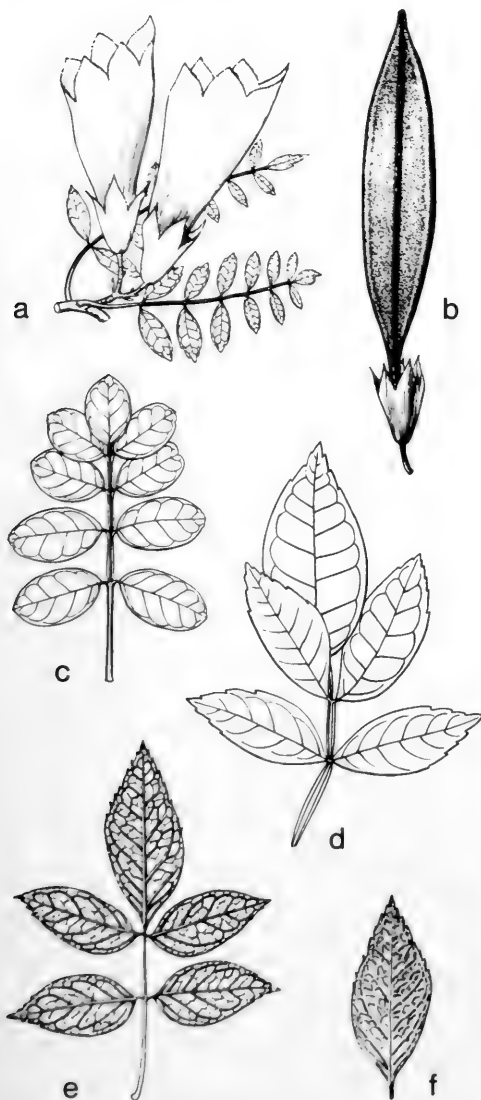


Fig. 35. *Tecomanthe volubilis* GIBBS. a. Habit, b. unripe capsule, c. leaf. — *T. volubilis* ssp. *silvicola* STEEN. d. Leaf. — *T. volubilis* ssp. *tenax* STEEN. e. Leaf, underside, f. leaflet, upper surface. All $\times \frac{1}{2}$ (a VAN ROYEN & SLEUMER 7417, b BRASS 9052, c BW 3050, d LEDERMANN 12904, e-f KALKMAN 5178).

3a. ssp. *silvicola* STEEN. nov. ssp. — *T. saxosa* DIELS, Bot. Jahrb. 57 (1922) 498; STEEN. Nova Guinea 14 (1927) 889, f. 5c; Thesis (1927) 297; Bull. Jard. Bot. Btzig III, 10 (1928) 211. — *T. cyclophensis* STEEN. Nova Guinea 14 (1927) 298, t. 34A; Thesis (1927) 895; Bull. Jard. Bot. Btzig III, 10 (1928) 214. — *T. nitida* (non STEEN.) HERKLOTS, Fl. Trop. Clim. (1976) 73, f. 98. — Fig. 35d.

Differt a T. volubili foliolis 2(-3)-jugatis, apice acutis vel cuspidatis; staminodiis plerumque $1\frac{1}{2}$ -3 cm longis. — *Typus*: VAN ROYEN & SLEUMER 7117 (L), NW. New Guinea, Vogelkop Peninsula, Tamrau Mts, 1350 m.

Slender liana. *Leaflets* 2(-3) pairs, mostly herbaceous to chartaceous, usually elliptic to ovate-oblong, or lanceolate-oblong, entire but mostly with several pairs of teeth, base cuneate to rounded, apex acute, lateral leaflets $\frac{3}{4}$ -5(-8) by $\frac{3}{4}$ - $2\frac{1}{2}$ (-3) cm, terminal one longest; pedicels $\frac{1}{2}$ -6 mm. *Racemes* axillary or on old wood. *Calyx* usually herbaceous, $1\frac{1}{2}$ -3(- $3\frac{1}{2}$) cm, halfway incised or \pm less. *Corolla* 5-7(-9-11) cm, including the lobes. *Capsule* flat, 8-12 by 2-3 cm. *Seeds* $1\frac{1}{2}$ -2 by 1- $1\frac{1}{2}$ cm.

Distr. Malesia: New Guinea (throughout, but far more common in East New Guinea, common in Morobe Distr.), 30 collections.

Ecol. In the understorey of *Nothofagus-Araucaria* and *Castanopsis* forest, more rarely in moss forest and on ridges, mostly in fairly tall forest, (1000-)1500-2400(-3000) m (once found at 80 m between Hollandia and Sentani). *Fl.* Jan.-Dec., *fr.* March, June, Oct.

Note. I regard this montane forest plant to represent a race of *T. volubilis*; it is rather variable in foliage, some specimens looking transitional to low altitude specimens of ssp. *volubilis*.

3b. ssp. *tenax* STEEN. nov. ssp. — Fig. 35e-f.

Differt a foliolis 2(-3)-jugatis, coriaceis, venis nervisque utrinque perspicue prominentibus. — *Typus*: LAE 60706, leg. CROFT *et al.*, E. Papua, S. slopes of Mt. Giluwe, 6°7' S, 143°55' E, fl. fr. 25-xii-1973 (L, iso in LAE).

Smallish liana, 2–10 m; branchlets puberulous to subglabrous. *Leaflets* 2-jugate (very rarely 1- or 3-jugate), dark green above, pale green beneath, glossy on both sides, ovate to lanceolate, coriaceous, not nigrescent, 2–5½(–8) by 1–2(–4) cm, terminal one largest, very tough, margin especially towards apex with sharp teeth. *Racemes* axillary, rarely terminal, lax, with (1–)2–3 pairs of flowers; rachis and pedicels \pm lax-puberulous; rachis 1–5 cm; pedicels 1¼–2½ cm. *Calyx* mostly thin, 2¼–3½ cm, tube 1½–2(–3) times as long as the lobes; reddish white to green with pink tinge; lobes triangular, mucronate. *Corolla* pink to crimson (once noted white), the lobes yellowish to white, streaked red within, 7–12 cm long including the triangular lobes c. 1½ by 1½ cm. *Capsule* 8–14 by 2–3 cm (septum 2½ cm stalked). *Seeds* c. 1½ by 1 cm including wing.

Distr. Malesia: New Guinea: Papua (E., S. & W. Highlands, largely c. 6° S and 143–144° E), but also in West New Guinea (Bernard Camp, Idenburg R.). Fig. 36.

Ecol. Mountain forest, often mossy, often with *Nothofagus* dominating, sometimes in shrubs

bordering glades, 1800–3000 m. *Fl.* June, Sept.–Jan. (once in May), *fr.* (twice) July, Dec.

Vern. *Tserki*, Enga lang., *taugurapu*, Tari, *igidumbroki*, Mendi lang.

Note. The material is very homogeneous in 25 collections seen and though fertile characters with *ssp. silvicola* are overlapping it can easily be recognized vegetatively without any transitions.

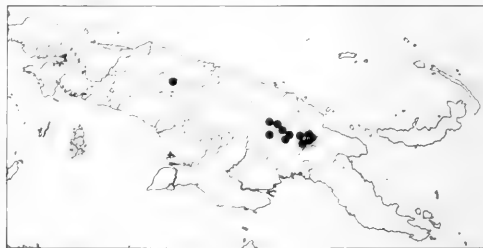


Fig. 36. Localities of *Tecomanthe volubilis* GIBBS *ssp. tenax* STEEN.

15. PANDOREA

SPACH, Hist. Vég. 9 (1840) 136; Mon. (1864) 49; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230; STEEN. Nova Guinea 14 (1927) 301, *incl. sect. Parviflores* STEEN., in *clav.*; Thesis (1927) 294; Proc. R. Soc. Queensl. 41 (1929) 43. — *Tecoma sect. Pandorea* ENDL. Gen. Pl. (1839) 711; DC. Prod. 9 (1845) 225. — *Tecomanthe sect. Montanae* STEEN. Bull. Jard. Bot. Botz III, 10 (1928) 204. — Fig. 37, 39.

Lianas, only exceptionally (in arid countries) erect. Glands on twig-nodes small. *Leaves* (1–)2–4(–7)–jugate; leaflets with microscopical glands and not rarely with few to many larger crateriform scattered glands underneath; petiole in some species with some ventral large glands near the base. *Thyrse*s terminal, sometimes additional partial axillary thyrse in the upper leaf-axils; peduncle without sterile bracts at the base; depauperate thyrse may appear occasionally as racemes. *Calyx* closed in bud, small (less than 7 mm), cup-shaped to campanulate, stunted or very shallowly lobed, sometimes tearing. *Corolla* generally small, the tube cylindric or infundibuliform, *incl. lobes* at most 5 cm long, limb usually zygomorphous, the lobes small or large, in bud widely imbricating; throat and ventral side of the tube mostly long-hairy and often with a hair-ring near the insertion of the anthers. *Stamens* didynamous, almost always inserted; anther-cells divaricate, c. 1½–2 mm long; 5th rudimentary. *Disk* annular or \pm pulvinous. *Ovary* elongate, each cell with 2 placentas and many ovules. *Capsule* stipitate, \pm beaked, rather thick, terete or \pm flattened; valves widely boat-shaped, firmly coriaceous; dissepiment flat, oblong, thickish, with marginal seed-scars. *Seeds* many, roundish, thin-winged.

Distr. Six *spp.*, Central, N. & E. Australia, Tasmania, Lord Howe I., New Caledonia, Solomons (Bougainville), and *East Malesia*: New Guinea (New Britain included), Moluccas, and the Lesser Sunda Islands (Lombok, Flores, Timor). Fig. 38.

Ecol. In Malesia in rain-forest, from sea-level to 2450 m.

KEY TO THE SPECIES

1. Corolla tube glabrous outside, usually rather wide, without hair-ring inside near the insertion of the stamens. Base of filaments glandular and also the ovary with similar sessile glands. Calyx cupular, c. 2–3 mm. Venation not prominent above. Filaments inserted close to the base of the tube, which is not narrowed **1. *P. pandorana***
1. Corolla tube (except at the very base) outside puberulous. Base of filaments without sessile glands. Venation above mostly prominent.
 2. Flowers large, 4–5 cm long (incl. lobes), white with crimson throat, the tube c. twice as long as the rounded lobes. Leaves 2-jugate, the entire leaflets blunt at apex, nerves and veins not distinctly prominent above. Queensland and New South Wales ***P. jasminoides* (LINDL.) K.SCH.**
 2. Flowers much smaller, at most $3\frac{1}{2}$ cm, the tube 4–6 times as long as the lobes; lobes less than c. 1 cm diameter. Leaflets acute, nerves and veins usually distinctly prominent above, mostly toothed towards the apex.
 3. Corolla 12–15 mm long, narrow-cylindric, the tube c. 6 times as long as the lobes. No hair-ring at the staminal base. Calyx 3–5 mm. Petiole above at base with one or a few large glands; leaf-rachis narrowly winged.
 4. Leaflets entire, 3–4-jugate, 5–12 by 2–5 cm. Corolla c. 12–13 mm, tube \pm curved, c. 2–3 mm wide, no beard in the mouth and tube, lobes c. 2 mm. Ovary orbicular, with sessile glands. Venation on upper surface of leaflets raised, but not fine-tessellate. Flowers cream-coloured, lobes and throat pink-shaded. Queensland. Cf. STEEN. Proc. R. Soc. Queensl. 41 (1929) 46, f. 1.
 - P. baileyana* (MAID. & R. T. BAKER) STEEN.**
 4. Leaflets apically toothed, (1–)2–3-jugate, 6–8 $\frac{1}{2}$ by 3 $\frac{1}{2}$ –4 cm. Corolla tube straight, c. 20 mm long, c. 5 mm wide, mouth and upper part of tube inside bearded, lobes c. 3–4 mm. Ovary obconical-oblong, eglandular. Venation on upper surface of leaflets raised, fine-tessellate. (Corolla tube yellow, the lobes white) **2. *P. stenantha***
 3. Corolla 20–35 mm long, the tube c. 4 times as long as the lobes, the mouth and upper part of the tube inside bearded. Calyx c. 6–7 $\frac{1}{2}$ mm. Petiole without glands; rachis narrowly winged; leaflets dentate in upper part, venation not fine-tessellate raised above.
 5. Corolla straight, tubular, 20–25 mm long, with yellow tube, the lobes white to pale red or streaked red, inside with a distinct hair-ring near the insertion of the stamens. Ovary \pm conical, eglandular. Pedicels slender, 1–2 cm **3. *P. montana***
 5. Corolla c. 30–35 mm long, white with pale yellow mouth, infundibuliform, with a fairly narrow lower part of the tube, widened apically, inside at the insertion of the stamens with a few hairs. Ovary ellipsoid, with sessile glands. Pedicels c. 5 mm. Queensland. Cf. STEEN. J. Arn. Arb. 12 (1931) 149, pl. 35 ***P. nervosa* STEEN.**

1. *Pandorea pandorana* (ANDR.) STEEN. Bull. Jard. Bull. Btzig III, 10 (1928) 198; Proc. R. Soc. Queensl. 41 (1929) 43; J. H. WILLIS, Handb. Pl. Vict. 2 (1972) 578; BEADLE, EVANS & CAROLIN, Fl. Sydney Reg. ed. 2 (1972) 502; HERKLOTS, Fl. Trop. Clim. (1976) 69, f. 91. — *Bignonia pandorana* ANDR. Bot. Rep. 2 (1800) t. 86. — *Bignonia pandorea* VENT. Jard. Malm. (1803) t. 43. — *Bignonia pandorae* SIMS, Bot. Mag. 22 (1805) t. 865. — *Tecoma australis* R. BR. Prod. (1810) 471; DC. Prod. 9 (1845) 225, incl. var. *meonantha* (LINK) DC.; BTH. Fl. Austr. 4 (1869) 537; BAILEY, Queensl. Fl. 4 (1901) 1134, incl. var. *pandorea* (VENT.). BAILEY (= var. typ.), var. *meonantha* et var. *linearis* BAILEY, l.c. pl. 45. — *Bignonia australis* AIT. Hort. Kew. ed. 2, 4 (1814) 34. — *Bignonia meonantha* LINK, En. Berol. 2 (1822) 130. — *Tecoma meonantha* SWEET, Hort. Brit. (1827) 284; G. DON, Syst. 4 (1838) 224; HARRIS, Wild Fl. Austr. (1938) 151, pl. 6 (as *T. australis*). — *Tecoma diversifolia* G. DON, Syst. 4 (1838) 225; DC. Prod. 9 (1845) 225. — *P. australis* SPACH, Hist. Nat. Vég. 9 (1840) 136; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230; DIELS, Bot. Jahrb. 57 (1922) 498; STEEN. Nova Guinea 14 (1927) 302; Thesis (1927) 859, incl. ssp. *pandorea* STEEN. l.c. 861, ssp. *meonantha* STEEN. l.c. 862, et ssp. *linearis* STEEN. l.c. 863; DOMIN Bibl. Bot. 22 (1929) 1153, incl. var. *oxleyi*, nom. illeg., et var. *meonantha*, l.c. 1154. — *Tecoma floribunda* CUNN. ex DC. Prod. 9 (1845) 225. — *Tecoma oxleyi* CUNN. ex DC. l.c.; J. M. BLACK, Trans. R. Soc. S. Austr. 39 (1915) 836;

WHITE & FRANCIS, Proc. R. Soc. Queensl. 37 (1926) 166; HARRIS, Wild Fl. Austr. (1938) 151, pl. 39. — *Tecoma ochroxantha* KTH & BOUCHÉ, Ind. Sem. Hort. Berol. (1847) 12, sec. BTH. 1869. — *Tecoma leptophylla* BL. Rumphia 4 (1849) 35; STEEN. Nova Guinea 14 (1927) 301, t. 33, *pro parte, pro fol. sol.* — *Tecoma austro-caledonica* BUREAU, Bull. Soc. Bot. Fr. 9 (1862) 163; MAID. Proc. Linn. Soc. N.S.W. 39 (1914) 382; COMPTON, J. Linn. Soc. Bot. 45 (1921) 373. — *Tecoma ceramensis* T. & B. Nat. Tijds. N. I. 25 (1863) 412; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 197, t. 5, incl. var. *elliptica* MIQ. — *P. austro-caledonica* SEEM. Gard. Chron. (1870) 1085; BAILL. Hist. Pl. 10 (1891) 40; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230; GUILLAUMIN, Fl. Nouv. Cal. (1948) 317 ('*austro-caledonicum*'); HEINE, Fl. Nouv.-Caléd. 7 (1976) 87, pl. 20. — *Campsidium filicifolium* BULL. Wholesale List New, Beaut. & Rare Pl. (1874) fig.; Cat., ex JOHNSON & HOGG, J. Hort. 51 (1874) 366; A. VAN GEERT, Cat. n. 74 (1874); T. MOORE, Fl. & Pom. (1874) 280. — *Tecoma filicifolium* NICHOLSON, Dict. Gard. 4 (1887) 13; cf. STEEN. Blumea 15 (1967) 146. — *Gelseminum pandorea* et *ochroxanthum* O.K. Rev. Gen. Pl. 2 (1891) 480. — *P. ceramensis* BAILL. Hist. Pl. 10 (1891) 40; K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230 ('*ceramica*'); STEEN. Nova Guinea 14 (1927) 302; Thesis (1927) 852. — *Tecoma pandorana* SKEELS, U.S. Dep. Agric. Bur. Pl. Ind. Bull. 282 (1913) 62. — *P. acutifolia* STEEN. Nova Guinea 14 (1927) 303, t. 34C; Thesis (1927) 855; Bull. Jard. Bot. Btzig III,



Fig. 37. *Pandorea pandorana* (ANDR.) STEEN. a. Habit, flowers and fruit, b. foliage of juvenile plants, both $\times \frac{1}{2}$. — *Neosepicaea aurantiaca* (DIELS) STEEN. c. Flower, $\times \frac{1}{2}$ (a after BLUME, b ZIPPEL s.n. New Guinea, c LEDERMANN 9561).

10 (1928) 196. — *P. poincillantha* STEEN. Nova Guinea 14 (1927) 302; Thesis (1927) 857, incl. var. *fragrans* STEEN. — *Tecoma doratoxylon* J. M. BLACK, Trans. Proc. R. Soc. S. Austr. 51 (1927) 383; GARDNER, En. Pl. Austr. Occ. (1930) 118. — *P. doratoxylon* J. M. BLACK, Trans. Proc. R. Soc. S. Austr. 61 (1937) 248; Fl. S. Austr. pt 4 (1957) 773, f. 1106. — *Campsis pandorana* STEEN. Fl. Males. I, 4 (1948) xxi. — Fig. 37a–b.

Malesian specimens: Often large liana, 20–30 m. Leaves 2–4(–6)-jugate; leaflets usually ovate-elliptic to oblong, mostly entire and acuminate, 3–10 by $1\frac{1}{2}$ –6 cm, glabrous, underneath with few or many scattered large crateriform glands, nerves not prominent above; midrib sulcate; lateral petiolules 0–10 mm; petiole without glands at the base above. Thyrses terminal, lateral or from old wood, c. (1–)5–20 cm, glabrous, rarely puberulous. Pedicels c. $\frac{1}{2}$ – $1\frac{1}{4}$ cm, rarely longer. Calyx cupular, stunted or short-lobed, thin, c. 2–3 mm. Corolla 1–2(–3) cm long including the lobes, mostly rather inflated-tubular, the tube mostly \pm twice as long as the lobes, glabrous outside, lobes mostly densely papillose-puberulous, mouth and tube inside bearded on the ventral side, light yellow, the zygomorphous limb and tube inside streaked or mottled red or purple dotted, without a hair-ring near the base of the stamens and no proper basal tube. Stamens included, at their base glandular-papillose, inserted very near the base of the tube. Ovary glandular-papillose. Capsule acute, c. (5–)9–12 by ($1\frac{3}{4}$ –) $2\frac{1}{2}$ –3 by $2\frac{1}{2}$ – $2\frac{1}{2}$ cm; valves coriaceous; dissepiment rather thick, $6\frac{1}{2}$ –8 by $1\frac{3}{4}$ –2 cm, the seed scars marginal. Seeds c. $2\frac{1}{2}$ –3 by $1\frac{1}{2}$ –2 cm including the hyaline wings.

Distr. Central, N. & E. Australia, Tasmania, Lord Howe I., New Caledonia, N. Solomons (Bougainville), and East Malesia: New Guinea (incl. New Britain), Moluccas (Morotai, Halmaheira, Ambon, Ceram, Key Is.), and Lesser Sunda Is. (Lombok, Flores, Timor); 65 collections.

Though *Tecoma filicifolium*, a juvenile form, was said to have come from Fiji, I have shown (1967, l.c.) that this hailed from New Caledonia.

Sims claimed that LODDIGES nurseries had received *Bignonia pandorae* from Norfolk I., but this seems to rest either on an erroneous localisation or on a cultivated source.

Ecol. In Malesia in primary and secondary rain-forest, from sea-level up to c. 2000(–2400) m, getting distinctly scarcer upwards of 1350 m. Fl. Jan.–Dec., fr. Oct.–Dec.

Taxon. A quite well recognizable species in spite of a fair degree of variability. This is in part ontogenetic, the juvenile form having narrow, many-jugate, crenate, small leaflets; these are sometimes still found on odd twigs of mature-foliaged plants.

The main variation is in Australia in the leaves, the rain-forest (type variety) form having ovate to elliptic 2-jugate leaflets, whereas in drier places 2–4-jugate leaves occur with lanceolate leaflets (described as *T. meonantha*), while in still more arid places the 2–6-jugate leaves have almost linear leaflets (described as *T. oxleyi* and *T. doratoxylon*). The latter form may at times be scrambling, bushy or even erect (spearwood bush) and carry racemose inflorescences. Though the typical representatives

of these three forms are distinct, they are connected by a clear series of specimens with intermediary characters, which already induced BAILEY to say that he named the three forms as varieties merely for convenience. Whether these forms are genetically different taxa (races) or merely phenotypic forms can only be established by experiments. BAILEY added that flowers of the type variety would emit a strongly disagreeable odour while *T. meonantha* would have fragrant flowers. This matter must be solved by field botanists.

In Malesia the 3–4-jugate leaves are often narrower, sessile, and also more toothed than the 2-jugate ones; it looks like a matter of lingering neoteny.

At higher altitudes, 1300–2000 m, leaflets tend to be more coriaceous. In SCHMUTZ 3178 the veins are by exception prominent above.

The New Caledonian form seems to be a local race with small flowers and small roundish, dentate leaves.

In rain-forest the leaflets are usually entire, or with a few coarse teeth towards the apex, and usually they have underneath a fair number of crater-like larger glands, in Australian specimens these are scarce or absent.

Lateral petiolules are usually short (2–5 mm), but in HYLAND 5092 they measure $1\frac{1}{2}$ cm.

1a. ssp. *timorensis* STEEN. nov. ssp.

Differt a speciminibus malayanis floribus comparate magnis (2–3 cm longis, lobis incl.), staminibus atque stylo exsertis, ceterum ore atque tubo floris barbis longis destitutis. — Typus: C. W. KOOY 363 (L), pr. Temef, S. Central Timor, fl. 18–VII–1966, c. 800 m.

Leaflets 2–4-jugate, without crateriform glands beneath. Calyx 2–4 mm, stunted, minutely 5-mucronulate. Corolla 2–3 cm long incl. lobes. Mouth and tube not bearded inside, the puberulous papillae from the lobes extending in the tube in a lax way. Stamens and style exserted.

Distr. Malesia: Lesser Sunda Is. (Timor); 4 collections.

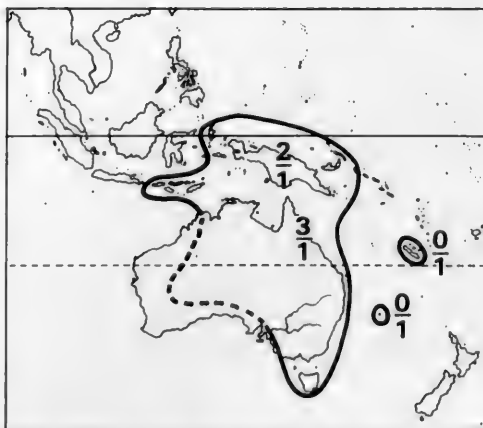


Fig. 38. Range of the genus *Pandorea* SPACH. Figures above the hyphen indicate endemic species, those below the hyphen non-endemic species.

Ecol. On limestone (once) and along ravine in mountain Eucalypt forest, c. 700–1000 m. *Fl.* March, May, July.

Vern. *Tufe*, Dawan lang., *non amisu*, Niki-Niki, *non fulèh*, Mt Mutis.

Notes. Though undoubtedly *P. pandorana*, the Timor race deviates within the species by lacking the usual beard in the mouth and tube of the corolla and in the genus by exerted stamens and style. It is remarkable that the specimens from Lombok and Flores do not belong to this subspecies but agree with the Moluccan specimens.

2. *Pandorea stenantha* DIELS, Bot. Jahrb. 57 (1922) 498; STEEN. Nova Guinea 14 (1927) 302; Thesis (1927) 850; Bull. Jard. Bot. Btzig III, 10 (1928) 197. — Fig. 39e–f.

Large liana (stem to $2\frac{1}{2}$ cm \varnothing). *Leaves* (1–)2–3-jugate, the leaflets coriaceous, ovate-oblong, acute, towards apex toothed, venation raised on both sides, above fine-tessellate, $6-8\frac{1}{2}$ by $3\frac{1}{2}-4$ cm; rachis narrowly winged; petiolules 0–8 mm; petiole near the base above with one or few large, sometimes raised glands, sometimes also one at the articulation of the rachis. *Thyraxes* axillary and

terminal or on old wood, 10–15 cm, fine-puberulous. Pedicels 4–10 mm. *Calyx* 3–5 mm, campanulate, with 5 short, broad-deltoid lobes. *Corolla* tube yellow, the lobes white (*ex typ.*), tube c. 20 mm long and c. 5 mm wide, outside puberulous-papillose, the mouth and upper part of the tube bearded, lobes c. 3–4 mm; no hair-ring at the insertion of the stamens. *Stamens* included. *Disk* cupular. *Ovary* flattened, obconical-oblong, glandless.

Distr. Malesia: New Guinea (Sepik Distr.: April R.; Mt Cyclops; SE. Irian: Ingembit); 3 collections.

Ecol. Rain-forest, 125–800 m. *Fl.* June, Nov. Flowers once noted to be fragrant.

Notes. Apparently a rare species; available flower material unfortunately rather inadequate. VAN ROYEN noted: flowers white at base of tube pale purple; SOEGENG: tube dirty yellow, lobes lilac. The petiolar glands were not mentioned by DIELS in his brief description, but I noted them on the type (1927).

3. *Pandorea montana* (DIELS) STEEN. nov. comb. — *Tecomanthe montana* DIELS, Bot. Jahrb. 57 (1922) 497; STEEN. Nova Guinea 14 (1927) 296; Thesis (1927) 875, f. 3c; Bull. Jard. Bot. Btzig III, 10 (1928) 204. — Fig. 39a–d.

Slender liana, to finger-thick. *Leaves* 3–4(–5)-jugate, leaflets chartaceous to coriaceous, elliptic-oblong, acute, towards apex toothed or shallowly crenate, venation raised on both sides, but not fine-tessellate above, c. $2-5\frac{1}{2}$ by $1-2\frac{1}{2}$ cm, rachis narrowly winged; petiole without basal glands; petiolules almost absent. *Thyraxes* axillary and terminal, lax, almost glabrous. Pedicels filiform, 1–2 cm. *Calyx* c. 7 mm, with 5 short, broad-triangular teeth. *Corolla* \pm infundibuliform, 20–25 mm long, the tube narrowed to the base, straight, limb zygomorphous, c. 8–10 mm wide at the mouth, the lobes 2–4 mm, bearded in the mouth and upper part of the tube, the lobes white to pale red or streaked red, the tube light brown or yellow flushed red outside, yellow inside, with a distinct suppose hair-ring near the insertion of the filaments. *Stamens* included. *Disk* cupular. *Ovary* \pm conical, eglandular. *Capsule* flattened, $4-8\frac{1}{2}$ by $1\frac{1}{2}-3$ by $\frac{1}{2}-1$ cm, sessile to stiped and short-beaked; valves hard, almost coriaceous to woody, narrow boat-shaped; dissepiment thick-coriaceous, 3–10 by $1\frac{1}{4}-2\frac{1}{2}$ cm. *Seeds* $1\frac{1}{4}-2\frac{3}{4}$ by 1–2 cm.

Distr. Malesia: East New Guinea (Sepik: Hunstein Mts: Lordberg, Hunsteinspitze, 1000–1350 m, 4 coll.), *loc. class.*; Morobe Distr.: Mt Kaindi, $7^{\circ}25'$, $146^{\circ}45'$ E, 12 coll.; Mt Giluwe, $6^{\circ}10'$, 144° E.

Ecol. Mountain rain-forest, often mossy, forest edges and regrowths, 1000–1350, 2100–2450 m. *Fl.* Febr., May–June, Aug.–Nov., fr. Aug.–Sept., Dec.

Notes. The thyrsoid inflorescence and flower-size point to congenity with *Pandorea*; luckily I had made in 1927 a small drawing of the type and observed several flower details on the original material not mentioned by DIELS in his brief description. Unfortunately almost all duplicates at L lack flowers, by careless distribution. The flower colour noted on labels varies rather considerably: tube cream, yellow, golden brown or red outside, lobes white, cream, pale purple, streaked red.

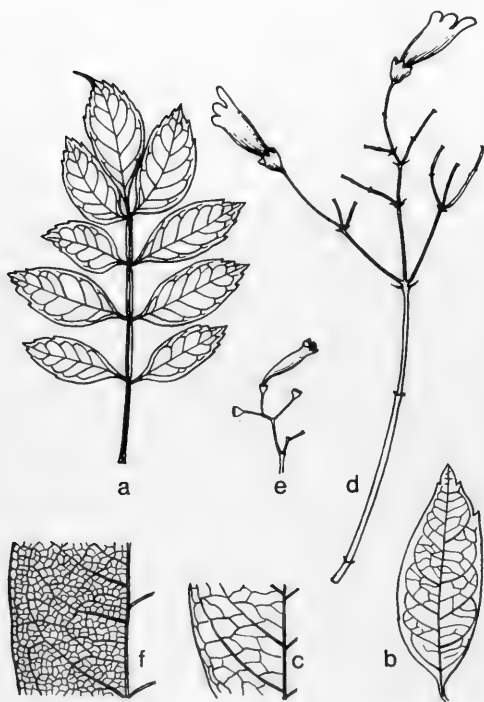


Fig. 39. *Pandorea montana* (DIELS) STEEN. a. Leaf, b. leaflet, $\times \frac{1}{2}$, c. reticulate venation above, d. inflorescence, $\times \frac{1}{2}$. — *P. stenantha* DIELS. e. Inflorescence, $\times \frac{1}{2}$, f. tessellate venation of leaflet above (a, c NGF 13905, b LEDERMANN 9916, d NGF 21251, e SOEGENG 360, f VAN ROYEN & SLEUMER 5816).

Doubtful & Excluded

In this list are combined all names of Malesian and SE. Asian plant names which are excluded or of which the identity is uncertain or of which I have not seen the types.

Bignonia albida BL. Verh. Bat. Gen. 9 (1823) 195; STEUD. Nomencl. 2 (1841) 204 = *Aeschynanthus albidus* (BL.) STEUD. (*Gesneriaceae*).

Bignonia angustifolia BL. Verh. Bat. Gen. 9 (1823) 194; Cat. Hort. Bog. (1823) 82 = *Aeschynanthus angustifolius* (BL.) STEUD. (*Gesneriaceae*).

Bignonia comosa ROXB. [Hort. Beng. (1814) 95, *nom. semi-nudum*] Fl. Ind. ed. Carey 3 (1832) 103; DC. Prod. 9 (1845) 144; MIQ. Fl. Ind. Bat. 2 (1858) 751. — *Spathodea comosa* G. DON, Gen. Syst. 4 (1838) 222, said to come from the Moluccas, is according to the type (Herb. Martius, in BR) *Clerodendron lanuginosum* BL. 1825 (*Verbenaceae*). The detached fruit on the sheet was not described and belongs to some SE. Asian *Bignoniaceae*.

Bignonia compressa LAMK, Encycl. 1 (1785) 424; G. DON, Gen. Syst. 4 (1838) 220, said to come from the East Indies, is according to PERRIER DE LA BÂTHIE from Madagascar (Fl. Madag. 178, 1938, 59) (*Colea decora* DC. Prod. 9, 1845, 241) = *Rhodocolea racemosa* H. PERRIER.

Bignonia fraxinoides PERROTTET, Mém. Soc. Linn. Paris 3 (1824) 102, *nom. semi-nudum*, said to grow in East Java, is *cf.* STEEN. Blumea 15 (1967) 146 probably not from Java; the name ought to be discarded entirely.

Bignonia glauca WALL. Cat. 6506, *nomen, non* DECNE 1844. The type at Kew, a sterile specimen, was annotated "perhaps not *Bignoniaceae*" by C. B. CLARKE. It has recently further been annotated "*prob. Meliaceae*" by ALAN RADCLIFFE-SMITH.

Bignonia hirsuta LAMK, Encycl. 1 (1785) 422; WILLD. Sp. Pl. 3 (1802) 299; G. DON, Gen. Syst. 4 (1838) 225. — *Tecoma hirsuta* DC. Prod. 9 (1845) 173, 222.

Said to have come from "l'Indes"; leaves opposite, digitate, with 5 leaflets, stalked and with petiolules; leaflets oblong, cuneate at base, emarginate at apex, downy, slightly pubescent beneath. Flowers small, curved, short reddish-yellow hairy. Calyx truncate, with 4 minute teeth. Stamens 4, exserted.

Vitex (*Verb.*) might be involved, but all its Indo-Malesian species have acuminate leaves and in *Vitex* the corolla is not curved and if hairy the corolla is greyish. It might possibly be an American plant, *Tabebuia*, or allied to that.

LAMARCK described the specimen from herb. Jussieu. Dr. H. HEINE made elaborate but unfortunately unsuccessful attempts in herb. Jussieu and Lamarck to locate the specimen in the Paris Herbarium; there is also no trace of it at Geneva; DE CANDOLLE did not see any material.

Bignonia laeta WALL. Cat. 6505A, *cf.* CLARKE, Fl. Br. Ind. 4 (1884) 376, is according to SPRAGUE, Kew Bull. (1919) 306 = *Dolichandrone serrulata* SEEM.

Bignonia longiflora REINW. msc. ex DE VRIESE, Pl. Ind. Bat. Or. (1856) 9, *nomen* = *Aeschynanthus longiflorus* (BL.) DC. (*Gesneriaceae*).

Bignonia macrostachya WALL. [Cat. 6504, *nomen*] ex G. DON, Gen. Syst. 4 (1838) 221; DC. Prod. 9 (1845) 166. Mr. R. K. BRUMMITT, Kew, kindly remarked on this (*in litt.* 15-VIII-1975) that "WALLICH 8504 consists of two rather long inflorescences in bud only (one corolla almost open) and a fairly stout piece of stem, and bears no leaves, open flowers or fruits. It has been annotated '*Bignonia macrostachya* WALL. (and of G. DON & DC.)' by C. B. CLARKE, but has no more recent identification. It seems to me to be fairly clearly referable to *Pajanelia longifolia* (WILLD.) K.SCH. My opinion seems to be supported by a specimen laid away in the main herbarium under this species in a red folder (though it is not obvious what it is supposed to be a type of), collected in Khasiya by GRIFFITH and labelled '*Bignonia macrostachya* WALL. Cat. 6504 & - *rostrata* WALL. Herb. 6503A'. The specimen WALLICH 6503A does indeed also seem to be this species. The citation of WALLICH 6505 by G. DON in validating the name *B. macrostachya* is presumably an error for 6504.

Bignonia moluccana DC. Prod. 9 (1845) 144; MIQ. Fl. Ind. Bat. 2 (1858) 751. — *B. discolor* A. RICH. Sert. Astrol. (1834) xxix, *non* R.BR. 1814, said to come from the Moluccas. The description would tally with *Gmelina asiatica* LOUR. (*Verbenaceae*), but a sheet with an original label (in P) was identified by E. BUREAU as *Bignonia capreolata* L. which does not agree with the description. Confusion with labels and specimens must have taken place and the name should be discarded. *Cf.* STEEN. Blumea 15 (1967) 146.

Bignonia purpurea THUNB. Fl. Jav. (1825) 15, *nomen*. Of unknown identity, not mentioned by JUEL.

Bignonia ramiflora DECNE, Nouv. Ann. Mus. Paris 3 (1834) 381, repr. Herb. Timor. Descr. (1835) 53. — ? *Bignonia coleii* G. DON, Gen. Syst. 4 (1838) 221. — *Colea ramiflora* DC. Prod. 9 (1845) 241; MIQ. Fl. Ind. Bat. 2 (1858) 759. — *Colea coleii* M. L. Green, Stand. Sp. Nom. Cons. (1926) 55-63; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 277, *excl. syn. alter.* — *Colea timorensis* in sched., in syn., ex PERRIER.

This rests on a mislocalized specimen of POIVRE in herb. Jussieu from Madagascar, and is according to PERRIER DE LA BÂTHIE, Ann. Mus. Col. Marseille 46 (1938) 43 = *Rhodocolea racemosa* H. PERRIER.

Bignonia ternatea REINW. ex DE VRIESE, Reinwardt's Reize (1858) 495, 644, *nomen* = *Dichrotrichum ternateum* REINW. ex DE VRIESE.

Bignoniaceae incerta: ZOLL. Syst. Verz. Heft 3 (1855) 53-54, based on ZOLLINGER 2214 = *Wightia borneensis* HOOK. *f. ssp. ottolanderi* (KOORD.) STEEN. (*Scrophulariaceae*).

Colea aberrans BAILL. Bull. Soc. Linn. Paris 1 (1889) 687 rests on a specimen said to have been collected by POIVRE in Timor, but came from Madagascar according to PERRIER DE LA BÂTHIE, Ann. Mus. Col. Marseille 46 (1938) 28, and = *Rhodocolea racemosa* PERRIER var. *humblottiana* H. PERRIER.

Dolichandrone falcata (WALL. ex DC.) SEEM.: F-VILL. Nov. App. (1880) 151. According to MERRILL, En. Philip. 3 (1923) 445, obviously an erroneous record from the Philippines of this Asian species.

Dolichandrone tulipifera BTH. in B. & H. Gen. Pl. 2 (1876) 1046; F.-VILL. Nov. App. (1880) 151; MERR. En. Philip. 3 (1923) 445. This is an erroneous, non-existing combination for *Spathodea tulipifera* G. DON which was used by F.-VILLAR for the tulip tree, *Spathodea campanulata*, which he saw cultivated at Manila.

Hadongia eberhardtii GAGN. Not. Syst. 14 (1950) 30, from Indo-China, is according to VIDAL, Bull. Soc. Bot. Fr. 106 (1959) 352 a cultivated specimen of *Citharexylum spinosum* L. (*Verbenaceae*).

Hausmannia mollis K.SCH. ex STEEN. in sched.; Thesis (1927) 902; *Hausemannia mollis* F.v.M. sphalm. Ind. Kew. Suppl. 1 (1906) 16 (*Hausemannia mollis* K.SCH.) = *Archidendron molle* (K.SCH.) DE WIT (*Leguminosae*).

Markhamia cauda-felina (HANCE) CRAIB; SPRAGUE, Kew Bull. (1919) 310. — *Dolichandrone sp.* CERON, Cat. Pl. Herb. Fl. For. Filip. (1892) 127. Now considered to be *Markhamia stipulata* (WALL.) SEEM. var. *cauda-felina* (HANCE) SANTISUK, cf. Thai For. Bull. Bot. 8 (1974) 15.

The collection on which this was based is VIDAL 3398 (K), from Montufar, Albay Prov., Luzon. MERRILL noted (J. Arn. Arb. 35, 1954, 154) that it was possibly occasionally introduced for forestry purposes by VIDAL from S. China. As no later collections were ever made its cultivation seems to have been ephemeral.

Stereospermum cylindricum PIERRE ex P. DOP, Fl. Gén. I.-C. 4 (1930) 581, a species from Indo-China and Thailand, was mentioned by DOP, l.c. 582 to occur in Malaya, but on what evidence is unclear. I found no sheets in Paris to corroborate this.

Tripinnaria tripinnata LOUR. Fl. Coch. (1790) 391. — *Tripinnaria cochinchinensis* PERS. Syn. 2 (1807) 173. — *Tripinnaria asiatica* SPRENG. Syst. 2 (1825) 842, taken for a *Bignoniaceae* by several authors. According to MERRILL, Comm. Lour. (1935) = *Vitex tripinnata* (LOUR.) MERR. (*Verbenaceae*).

CULTIVATED BIGNONIACEAE

There are quite a number of *Bignoniaceae* cultivated in Malesia; they stem from all parts of the tropics. Frequently they hardly set any seed. *Tecoma stans* does so profusely and this has led to its naturalization. *Jacarandas* also set seed but did not naturalize.

As *Bignoniaceae* are often very showy plants and are largely tropical there is no end to their introduction. Therefore the survey given below may be or at least become incomplete.

It should also be remembered that cultivated plants are often neglected by botanical explorers and are mostly scantily represent in herbaria.

These introduced species have mostly not been critically studied by me, but it is assumed that their names are correct. I acknowledge with great thanks the loyal collaboration of the late Mr. N. J. SANDWITH (Kew) who formerly named at my request certain introduced species, and of Dr. A. H. GENTRY (Missouri Botanical Garden, St. Louis) who was so kind as to check this appendix.

Some papers or appendices are dedicated solely to cultivated *Bignoniaceae* or have taken them up and often give keys and illustrations:

BACKER, C. A. & BAKHUIZEN VAN DEN BRINK Jr, R. C. 1965. Flora of Java 2: 534–542.

CHATTERJEE, D. 1948. A review of *Bignoniaceae* of India and Burma. Bull. Bot. Soc. Beng. 2: 75–79.

FABRIS, H. A. 1959. Las plantas cultivadas de la Republica Argentina. Bignoniaceae. Inst. Bot. Agr. 10, fasc. 173: 57 pp., 25 fig.

GENTRY, A. H. 1973. Ann. Mo. Bot. Gard. 60: Flora of Panama, part IX, fam. 172: 781–977, 41 fig.

HEINE, H. 1976. Flore de Nouvelle-Calédonie 7: 91–93.

HERKLOTS, G. 1976. Flowering tropical climbers: 63–74, fig. 80–101, col. pl. 5–7.

HOLTUM, R. E. 1941. The *Bignonia* family in Malayan gardens. M.A.H.A. Mag. 11: 3–11.

SANTISUK, T. 1974. *Bignoniaceae*. Thai For. Bull. Bot. 8: 1–46.

SYKES, W. R. 1966. Studies of cultivated plants in New Zealand. 1. *Bignoniaceae*. New Zeal. D.S.I.R. Inf. ser. 54: 63 pp., 25 fig.

ARTIFICIAL KEY TO CULTIVATED BIGNONIACEAE IN MALESIA

1. Climbing plants.

2. Leaves at least 2-jugate. Tendrils absent.

3. Stamens exserted. Corolla narrow-tubular, scarlet or sulphur-yellow *Tecoma capensis*

3. Stamens included. Corolla not narrow-tubular, lavender or white streaked with carmine.

4. Calyx truncate, at most 6 mm, including minute teeth, not inflated.

5. Corolla c. 4–5 cm long, white with crimson throat, the tube puberulous outside. Calyx c. 6 mm. *Pandorea jasminoides*

5. Corolla (1)–2–3 cm long, pale yellow, lobes purple dotted or streaked, the tube glabrous outside.
Calyx 2–3 mm **Pandorea pandorana**
4. Calyx campanulate, inflated, white, distinctly 5-lobed, 1½ cm long **Podranea ricasoliana**
2. Leaves 1-jugate. Tendrils in a number of leaves present.
6. Corolla lobes valvate; tube narrow, without a distinct basal tube. Stamens exserted. Flowers bright orange **Pyrostegia venusta**
6. Corolla lobes imbricate.
7. Calyx spatheous, thin, 3 cm long. Corolla very large, rose-purple, (5)–7–9 cm. Disk absent.
 **Phryganocydia corymbosa**
7. Calyx regular, not spatheous. Disk present.
8. Inflorescence, calyx and outside of corolla tube densely hairy.
9. Calyx 5–6 mm long, 6–8 mm wide at the mouth. Inflorescence pauciflorous, almost a raceme, with 2–4 pairs of opposite flowers. Tendrils branched **Pithecoctenium cynanchoides**
9. Calyx 3–4 mm long, 2½–4 mm wide at the mouth. Thyrses rich-flowered, the flowers in triad cymes. Tendrils unbranched **Arrabidaea mollissima**
8. Inflorescence, calyx and outside of corolla tube glabrous.
10. Tendrils undivided. Leaves obovate with long-cuneate base, the two basal nerves straight, running up over halfway the blade, in the narrow angle with the midrib a large dark coloured gland field. Pseudostipules present **Saritaea magnifica**
10. Tendrils 3-parted. Leaves not obovate, and no such gland field in the narrow angle at the base.
11. Corolla yellow, outside of lobes glabrous or lepidote. Plant without garlic odor.
12. Tendril with 3 claws. Pseudostipules scale-like. Calyx thin, broadly campanulate **Macfadyena unguis-cati**
12. Tendril 3-fid. Pseudostipules foliaceous, 5–7(–15) mm in diameter. Calyx coriaceous, cupular. **Anemopaegma chamberlainii**
11. Corolla pale mauve to pale purple, outside of lobes puberulous. Plant smelling of garlic.
 **Pachyptera hymenaea**
1. Erect shrubs or trees.
13. Leaves in scattered fascicles. Fruit indehiscent, hard-shelled with fleshy pulp.
14. Leaves simple **Crescentia cujete**
14. Leaves 3-foliolate, petiole winged **Crescentia alata**
13. Leaves decussate or in whorls. Fruit dehiscent or fleshy and without a hard shell.
15. Leaves simple.
16. Leaves elliptic on a long, slender petiole. Thyrses terminal. Capsule linear with long-hairy, linear seeds. Unarmed tree **Catalpa longissima**
16. Leaves small, obovate, tapering into the base; no proper petiole. Flowers ramiflorous. Fruit an oblong berry. Twig nodes with a pair of thorns **Parmentiera aculeata**
15. Leaves compound.
17. Leaflets 3, sessile, articulated on top of a winged petiole. Fruit fleshy.
18. Branchlets usually with 2 short, ascending thorns at most nodes. Fruit costate and curved, less than 17 cm long **Parmentiera aculeata**
18. Branchlets unarmed. Fruit neither curved nor costate, usually more than 30 cm long, candle-like.
 **Parmentiera cereifera**
17. Leaflets 5 or more.
19. Leaves digitately compound. Leaflets 5.
20. Leaflets stellate-hairy beneath. Flowers yellow. Calyx rusty stellate-tomentose **Tabebuia chrysantha**
20. Leaflets lepidote, otherwise glabrous. Flowers pink. Calyx lepidote.
21. Leaflets acuminate or sharply acute. Inflorescence usually many-flowered. Mature capsule more than 22 cm long **Tabebuia rosea**
21. Leaflets obtuse. Inflorescence few-flowered. Mature capsule usually less than 15 cm long
 **Tabebuia pallida**
19. Leaves pinnate.
22. Leaves 2-pinnate.
23. Corolla infundibuliform, lilac. Capsule broad-ellipsoid, with woody valves. Staminode longer than the stamens, glandular-pubescent, especially at apex.
24. Corolla glabrous, distinctly sigmoid. Leaflets acute, with oblique base.
 **Jacaranda obtusifolia ssp. rhombifolia**
24. Corolla densely short-hairy, not sigmoid. Leaflets cuspidate, base hardly oblique
 **Jacaranda mimosifolia**
23. Corolla salver-shaped, white, the tube 6–8 cm long, 2 mm wide. Capsule linear. Staminode absent **Millingtonia hortensis**
22. Leaves 1-pinnate.
25. Calyx coarse, 2–7 cm long. Corolla wide-campanulate, coarse and large.
26. Calyx irregularly lobed, 2–3 cm. Flowers inside dark red, nocturnal, in long, pendent racemes. Berry massive, sausage-shaped **Kigelia africana**
26. Calyx spatheous, 4–7 cm. Flowers orange-red, in erect terminal thyrses, diurnal. Capsule dehiscent, with winged seeds **Spathodea campanulata**
25. Calyx short 5-lobed, 5–6 mm. Flowers not coarse.

27. Corolla infundibuliform, yellow, with included stamens. Leaflets lanceolate, serrate, sometimes deeply incised **Tecoma stans**
 27. Corolla narrow-tubular, usually orange red, sometimes sulphur-yellow, with exserted stamens. Leaflets ovate, dentate **Tecoma capensis**

Anemopaegma chamberlaynii (SIMS) BUR. & K.SCH. Fl. Bras. 8, 2 (1896) 128; HERKLOTS, Fl. Trop. Clim. (1976) 65, f. 82. — *Bignonia chamberlaynii* SIMS, Bot. Mag. (1820) t. 2148. — *Bignonia scandens* VELL. Fl. Flum. 6 (1825) 232, t. 22. — *A. scandens* MELLO ex K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 215; BACK. & BAKH. f. Fl. Java 2 (1965) 536.

Glabrous. Pseudostipules foliaceous, ovate to ± orbicular, 5–7(–15) mm. Leaflets ovate-oblong, to lanceolate-oblong, acute, 5–14 by 2½–5½ cm. Tendrils 3-fid. Flowers in 2–8-flowered axillary racemes. Calyx campanulate, truncate, 7–8 mm. Corolla 4–5 cm, pale yellow.

Distr. Brazil, introduced in East Java as an ornamental, at Malang and Kali Baru (Besuki), 250–600 m; also seen from Rangoon, Burma (DICKASON 6660). All Asian material has smallish ovate leaflets, 5–6 by 2½–3½ cm and smallish acute pseudostipules 5–7 mm long; in America both can obtain much larger size.

Arrabidaea mollissima (H.B.K.) BUR. & K.SCH. Fl. Bras. 8, 2 (1896) 46; SEIBERT, Carnegie Ins., Wash. 522 (1940) 406; DUGAND, Caldasia 3 (1945) 255.

Leaves patent, lax hairy, the longer hairs mostly gland-tipped; leaflets ovate, acuminate, 4–12½ by 2½–7½ cm. Flowers pink to rose, 3½–5 cm, mouth whitish with yellow spot.

Distr. Mexico and Central America to Colombia and Venezuela; cultivated in the vicinity of Manila.

Catalpa longissima (JACQ.) DUM. Cours. Bot. Cult. 2 (1802) 190; SMS, Bot. Mag. (1808) t. 1094; SANDWITH, Rec. Trav. Bot. Néerl. 34 (1937) 228; ADAMS, Fl. Pl. Jamaica (1972) 669; LITTLE JR., Trees Puerto Rico & Virgin Is. 2 (1974) 890, f. 700. — *Bignonia longissima* JACQ. En. Pl. Carib. (1760) 25. — *Macrocatalpa longissima* BRITTON, J. N.Y. Bot. Gard. 19 (1918) 8.

Tree up to 30 m, occasionally deciduous. Petioles slender; blades ovate-lanceolate, acute, (3–)5–11 by (1½–)2–4 cm. Flowers in small panicles, white, pinkish on the lobes, yellow in mouth with purple markings, 2½–3 cm long. Calyx 2-cleft. Capsule 35–75 cm by 4 mm.

Distr. Jamaica, Hispaniola, Martinique, introduced for ornamental or forestry purposes in other tropics, e.g. in the Marianas (Guam, Saipan) and the Philippines (Luzon: Lamo For. Res.).

Vern. *French oak*, *Haitian oak*, *Mast-wood*, *Yoke-wood*, E.

Crescentia alata H.B.K. Nov. Gen. Sp. 3 (1819) 158; F.-VILL. Nov. App. (1880) 151; VIDAL, Sinopsis Atlas (1883) 35, t. 73, f. C; MERR. Fl. Manila (1912) 430; Sp. Blanc. (1918) 350; En. Philip. 3 (1923) 447; STANDLEY, Trees Shrubs Mex. (1926) 1324; BACK. & BAKH. f. Fl. Java 2 (1965) 542; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 829. — *C. trifolia* BLANCO, Fl. Filip. (1837) 489; DC.

Prod. 9 (1845) 247; BLANCO, Fl. Filip. ed. 3. 2 (1878) 271, t. 327. — *Otophora paradoxa* BL. Rumphia 3 (1847) 146; MIQ. Fl. Ind. Bat. 1, 2 (1859) 560 (L). — *Parmentiera alata* MIEERS, Trans. Linn. Soc. Bot. 26 (1870) 166.

A crooked tree, 5–14 m, to 25 cm Ø. Leaves in scattered fascicles on the twigs, with a winged petiole, 2½–11 cm; leaflets brittle, lanceolate-obspathulate, sessile, 1–4½ cm. Flowers 1–2 rami- and cauliflorous; calyx 2-lobed to the base; corolla brownish with brown-purple venation, rank-scented, with a transversal fold, 4–6 cm. Fruit with a hard shell, ± globular, 5–10 cm Ø.

Distr. Mexico to Costa Rica, from Mexico early introduced by the Spaniards via Guam in the Philippines, also in Java (rare) and Rabaul (New Britain).

Vern. Philippines: *cruz-cruzan*, Tag., *hoja cruz*, Spanish.

The pulp is in Mexico sometimes used as a medicine; the shells are less in demand than those of *Crescentia cujete*, but used for the same purposes. No fruits seen from Malesia.

Crescentia cujete LINNÉ, Sp. Pl. (1753) 626; STANDLEY, Trees Shrubs Mex. (1926) 1324; STEEN. Thesis (1927) 1010; Bull. Jard. Bot. Btzg III, 10 (1928) 274; SEIBERT, Carnegie Inst. Wash. 522 (1940) 383; BACK. & BAKH. f. Fl. Java 2 (1965) 542; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 831. — *C. ovata* BURM. f. Fl. Ind. (1768) 132, *nom. semi-nudum* (G).

Crooked tree to 10 m, 30 cm Ø. Leaves in scattered bundles on the rough twigs, obspathulate, sometimes short-acuminate, without petiole, up to 26 by 7½ cm. Flowers solitary or in pairs on the twigs, of a musty odor; calyx 2-lobed to the base; corolla 4–7 cm, dirty white or pale greenish, purplish veined, finally turning dull purplish, the wide tube with a transversal fold. Fruit broad-ellipsoid to globular, 13–20 by up to 30 cm, indehiscent, with a hard shell.

Distr. Central America, very widely and early distributed in the American and other tropics, throughout Malesia, in the lowland, grown in lawns, parks and used for hedges.

Vern. *Tabu kaju*, S. Sum., *bila*, Djakarta, *sēkopāl*, *sikadel*, J, *bila radja*, Kangean, *bila bilanda*, Makas., *calabassa*, Moluccas, *bēr(e)nuk*, S, *bua no*, Ternate, *buwano*, Halmahera, *Calabash tree*, E.

The pulp is sometimes used for medicinal purpose and the hard shells are commonly in use for drinking cups, vessels, and carving.

The flowers are bat-pollinated. Cf. PORSCH, Oest. Bot. Z. 80 (1931) 31–44, t. 9–10.

I saw the type of *C. ovata* BURM. f. which was described from Java and which was in Index Kewensis reduced to *C. cucurbitina* L. (now *Amphitecna latifolia* (MILL.) GENTRY); the type consists of 3 leaves and a single damaged flower; the sheet carries no name, but the note 'Kalbas, 4 stam., 1 pistile'.

Jacaranda mimosifolia D. DON, Bot. Reg. 8 (1822) t. 631. — *J. ovalifolia* R. BR. Bot. Mag. 49 (1822) t. 2337. — *J. acutifolia* (non H. & B.) auct.; STEEN. Bull. Jard. Bot. Botz III, 10 (1928) 270; BACK. & BAKH. f. Fl. Java 2 (1965) 239.

Distr. Tropical America, Bolivia to NW. Argentina. Seen from W. Java, Hawaii, S. Africa, Madagascar, Congo. Perhaps not distinct from the Peruvian *J. acutifolia* H.B.K.

Suitable as a roadside tree and in parks. Flowers often when leaves are shed.

The names of DON and BROWN were published on the same day on material from the same source; a unique nomenclatural case!

Jacaranda obtusifolia H.B.K. ssp. *rhombofolia* (G. F. W. MEIJER) GENTRY, Mem. N.Y. Bot. Gard., in the press. — *J. rhombifolia* G. F. W. MEIJER, Fl. Esseq. (1818) 213. — *J. filicifolia* D. DON, Edinb. Phil. J. 9 (1823) 266; STEEN. Bull. Jard. Bot. Botz III, 10 (1928) 269; HOLTUM, M.A.H.A. Mag. 3 (1933) 188, fig.; BACK. & BAKH. f. Fl. Java 2 (1965) 239.

Distr. Northern South America, Venezuela to Guiana. Seen from Malaya, Java (W. Java, also Semarang and Malang), and Borneo (Sandakan, Kuching).

Good roadside tree, and for large gardens and parks.

Kigelia africana (LAMK) BTH. in Hook. Niger Fl. (1849) 463; SPRAGUE, Fl. Trop. Afr. 4, 2 (1906) 536; MERR. Fl. Manila (1912) 430; En. Philip. 3 (1923) 444; H. HEINE in HUTCH. & DALZ. Fl. W. Trop. Afr. ed. 2, 2 (1963) 385; MEXM. & SCHREIB. Prod. Fl. SW. Afr. fam. 128 (1967) 3. — *Bignonia africana* LAMK, Encycl. 1 (1785) 424. — *Crescentia pinnata* JACQ. Coll. 3 (1789) 203, t. 18. — *Tecoma africana* G. DON, Gen. Syst. 4 (1838) 224. — *K. pinnata* DC. Prod. 9 (1845) 247; KOENS, Trop. Natuur 1 (1912) 167, 6 f. — *K. aethiopica* (FENZL) DECNE in DELESS. Ic. Sel. Pl. 5 (1845) 39, t. 93; STEEN. Bull. Jard. Bot. Botz III, 10 (1928) 275; BACK. & BAKH. f. Fl. Java 2 (1965) 542. — See for further synonyms HEINE, *vide supra*.

Widely branched tree, to 20 m. Leaves decussate or in whorls of 3–4, up to 50 cm; leaflets oblong, entire or serrate distally, glabrous or hairy on nerves, to 20 by 6 cm. Flowers nocturnal, coarse, in terminal, pendent, narrow panicles up to 2 m long; calyx greenish, 2–3 cm, 2-lipped; corolla outside yellowish, veined, inside dark wine-red, 5–10 cm; basal tube as long as the calyx or longer. Berry sausage-like, 25–50 by 7½–15 cm, often on still flowering panicles.

Distr. Africa, widely cultivated in other tropics as an ornamental tree in parks and along roads, in Malasia not rare.

HEINE *l.c.* concluded that the genus consists of one species only as the species distinguished by STAPF are racial and grading.

The calyx contains much watery slime in bud (*cf.* KOORD. Ann. Jard. Bot. Botz 14, 1897, 407–411). The flowers are in Malasia invariably visited by bats. *Cf.* FAIRCHILD, Trop. Gard. Bull. July 1968, 5; HARRIS & BAKER, The Nigerian Field 40: 151–158; J. West Afr. Sc. Assoc. 4 (1958) 25–30; KOENS, Trop. Natuur 1 (1912) 167, f. 1–6; McCANN, J. Bomb. Nat. Hist. Soc. (1931) 467–471,

3 f. They are, however, also frequented by hawk-moths and HARRIS & BAKER *l.c.* concluded that bats are not essential pollinating visitors.

Macfadyena unguis-cati (L.) A. GENTRY, Brittonia 25 (1973) 236; Ann. Mo. Bot. Gard. 60 (1973) 874. — *Bignonia unguis-cati* LINNÉ, Sp. Pl. (1753) 623. — *Doxantha unguis-cati* MIERS *em.* REHDER, Mitt. Deut. Dendr. Ges. (1913) 262; HERKLOTS, Fl. Trop. Clim. (1976) 66, f. 87. — *Bignonia tweediana* LINDL. Bot. Reg. 26 (1840) t. 45, non GRISEB.; BUYSMAN, Flora 107 (1915) 361, cult. in Java. — ? *M. dentata* BUR. & K. SCH. Fl. Bras. 8, 2 (1897) 291; STEEN. Bull. Jard. Bot. Botz III, 10 (1928) 186; BACK. & BAKH. f. Fl. Java 2 (1965) 538.

Leaves very variable, those of juvenile plant appressed to substratum, very small; later to 5 by 3½ cm, ovate, dentate, but in other forms elliptic-oblong and hardly dentate. Calyx irregularly lobed to spathaceous or subspathaceous. Corolla 4½–8 cm.

Distr. Mexico to Brazil and N. Argentina, sometimes cultivated in Malasia.

Specific characters in this genus seem to be vague; those used to distinguish *M. uncata* (ANDR.) SPRAGUE & SANDW. from *M. unguis-cati* by GENTRY (Ann. *l.c.* 871) he declared himself (Brittonia *l.c.* 236) as inconstant. The one specimen I have seen from Java agrees with the plate of *M. dentata* but for the non-spathaceous calyx. Shape of calyx, margin of leaves and length of corolla seem to be very variable in this species which has already a very large synonymy (GENTRY, Ann. *l.c.* 871). Does not fruit in Java; propagated by suckers and cuttings.

Millingtonia hortensis L. f. Suppl. (1781) 291. See for a full treatment p. 133.

Distr. SE. Asia, probably also native in the Lesser Sunda Islands.

Suitable as a tree for roadsides and parks.

Pachyptera hymenaea (DC.) GENTRY, Brittonia 25 (1973) 236; Ann. Mo. Bot. Gard. 60 (1973) 888, with full synonymy.

Glabrous liana. Vegetative parts smelling of garlic. Pseudostipules bract-like, 1½ mm. Leaflets triplinerved, ovate-oblong, short-acuminate, 3½–7 by 1½–3 cm; venation prominent on both sides. Flowers in short axillary racemes. Calyx tube 4–5 mm, with minute prominent pustular glands. Basal tube of corolla twice as long as calyx, in all 3–4 cm. Anthers glabrous. Fruit flattened, 16–22 by 1¼–1½ cm; valves with a central rib. Seeds 1–1½ by 3–3½ cm, incl. the membranous wing.

Distr. A common liana ranging from Mexico to Brazil of tropical dry forest, sporadically also in moist forest, introduced in the Philippines (Manila, Mindanao) and E. Java (Surabaya).

Another species may also be cultivated which is in flower not easy to distinguish from *P. hymenaea*, viz *P. alliacea* (LAMK) GENTRY; this latter species has a short oblong fruit with thick, corky wingless seeds.

The genus *Pseudocalymna* SAMP. & KUHLM. has been reduced to *Pachyptera* A.DC. by GENTRY (*l.c.*).

Pandorea jasminoides (LINDL.) K. SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 230; STEEN. Thesis

(1927) 847; Bull. Jard. Bot. Btzg III, 10 (1928) 195; Proc. R. Soc. Queensl. 41 (1929) 48; BACK. & BAKH. f. Fl. Java 2 (1965) 538; HERKLOTS, Fl. Trop. Clim. (1976) 69, f. 90. — *Tecoma jasminoides* LINDL. Bot. Reg. (1939) t. 2002.

Fairly tall climber; leaflets 4–7(–9), lanceolate, blunt, $2\frac{1}{2}$ –5 by 1–2 cm. Corolla white streaked with carmine in the mouth, 4–5 cm long, short hairy.

Distr. NE. Australia, not rarely cultivated in the tropics and also subtropics (Mediterranean, N. New Zealand), in Malesia rarely cultivated (e.g. West Java), in the temperate zone in greenhouses.

Propagated by cuttings; seeds very rare.

Pandorea pandorana (ANDR.) STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 198; BACK. & BAKH. f. Fl. Java 2 (1965) 538. For full references see p. 176.

Distr. East Australia, New Caledonia, Lord Howe I., Solomons (Bougainville), New Guinea, Moluccas, and Lesser Sunda Islands.

In Malesia an unfrequent ornamental, but cultivated here and there through the tropics and subtropics (also in the Mediterranean and N. New Zealand).

Propagated by tjankoks (marcotting) and cuttings.

Parmentiera aculeata (H.B.K.) SEEM. Bot. Voy. Herald (1854) 183; SEIBERT, Carnegie Inst. Wash. 522 (1940) 385; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 899. — *Crescentia edulis* DESV. J. Bot. 4 (1874) 112. — *Crescentia aculeata* H.B.K. Nov. Gen. Sp. 3 (1819) 158. — *P. edulis* DC. Prod. 9 (1845) 244 (heterotypic with *Crescentia edulis* DESV.).

Tree 7–8 m. Leaves articulated with very hard, thorny extension of the nodal bark, the latter remaining a permanent, ascending, sharp thorn; leaflets elliptic, narrowed at both ends, 2–5 by 1–3 cm; axillary fascicled leaves mostly simple. Flowers 1-several together, terminal, axillary or on branches or stem. Calyx spathaceous, 3–5 cm; corolla white, 6–7 cm. Berry pendent, cylindric, curved, costate with thick ribs, 8–17 cm by over 3 cm \varnothing .

Distr. S. Mexico to northern Central America, cultivated elsewhere in the tropics; in Malesia rare: W. Java, Luzon, also seen from Cairns (N. Queensland).

Young sterile offshoots have no thorns and possess coarsely dentate leaflets.

Parmentiera cereifera SEEM. in Hook. J. Bot. & Kew Gard. Misc. 3 (1851) 302; Bot. Voy. Herald (1854) 182, t. 32; STEEN. Thesis (1927) 1008; Bull. Jard. Bot. Btzg III, 10 (1928) 272; BACK. & BAKH. f. Fl. Java 2 (1965) 542.

Tree to 7 m, 20 cm \varnothing . Leaflets oblong, acuminate, 4–8 by $1\frac{1}{2}$ – $3\frac{1}{2}$ cm. Flowers cauliflorous, nocturnal, white, slightly fragrant. Calyx spathaceous, 3 cm; corolla 5–6 cm. Berry pale yellow, pendent, candle-like, smooth, 30–100 by $1\frac{1}{2}$ – $2\frac{1}{2}$ cm.

Distr. Panama, cultivated in many tropical countries, and in many parts of Malesia in parks and gardens. With its waxy-fleshy, candle-like fruits a showy plant.

Vern. *Candle tree*, E. *kaarsenboom*, D.

The flowers are bat-pollinated, as in *Crescentia*. In Panama fruits are utilized as cattle food (SEEMANN).

Phryganocydia corymbosa (VENT.) BUR. ex K.SCH. in E. & P. Nat. Pfl. Fam. 4, 3b (1894) 224, f. 89H; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 905; HERKLOTS, Fl. Trop. Clim. (1976) 69, col. pl. 6. — *Spathodea corymbosa* VENT. Choix (1807) t. 40.

Sometimes pseudostipules. Leaflets (4–)12–15 by (2–)7–9 cm, triplinerved. Calyx spathaceous. Corolla lavender to blue purple, with a white mouth.

Distr. Panama to Brazil, cultivated at Seria (Brunei).

A Brunei specimen (VAN NIEL 3826) identified by A. A. ATCHLEY (1973).

Pithecoctenium cynanchoides DC. Prod. 9 (1845) 193; FABRIS, Rev. Mus. La Plata 9, Bot. n. 49 (1965) 353, f. 19.

Leaves reniform-triangular acuminate, ciliate at the margin, $2\frac{1}{2}$ –4 by 2–4 cm. Corolla 3–6 cm, white with yellow markings in the mouth.

Distr. Southern Brazil to Argentina, in E. Java once cultivated (Mt Tengger: BUYSMAN).

Podranea ricasoliana (TANF.) SPRAGUE, Fl. Cap. 4, 2 (1904) 450; SYKES, New Zeal. D.S.I.R. Inf. ser. 54 (1966) 39, f. 16; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 916, f. 29; HERKLOTS, Fl. Trop. Clim. (1976) 70, f. 92. — *Tecoma ricasoliana* TANF. Bull. Soc. Tos. Ort. (1887) 17, t. 1–2. — *Pandorea ricasoliana* BAILL. Hist. Pl. 10 (1891) 40.

Leaflets 7–9, crenate, $2\frac{1}{2}$ –4 by 1–2 cm. Corolla pale lavender or pinkish, with magenta patches and lines in the mouth and tube, 6–8 cm long, in terminal thyrses.

Distr. South Africa, cultivated elsewhere in the tropics (e.g. in the Philippines, New Caledonia) and subtropics (Mediterranean, New Zealand).

Pyrostegia venusta (KER) MIERS, Proc. R. Hort. Soc. Lond. 3 (1863) 188; STEEN. Bull. Jard. Bot. Btzg III, 10 (1928) 189; BRUGGEMAN, Ind. Tuinb. (1939) 64, f. 21; BACK. & BAKH. f. Fl. Java 2 (1965) 536; SYKES, New Zeal. D.S.I.R. Inf. ser. 54 (1966) 22, f. 6; HERKLOTS, Fl. Trop. Clim. (1976) 71, f. 94. — *Bignonia venusta* KER, Bot. Reg. (1818) t. 249; Bot. Mag. (1819) t. 2050. — *Tecoma venusta* LEM. Hort. Univ. (1834) 1, icon. — *P. ignea* (VELL.) PRESL, Bot. Bemer. (1845) 93.

Leaflets ovate-lanceolate, 4–6 by 3–4 cm. Thyrses dense, rachis 10 cm. Calyx 6–7 mm. Corolla tube c. 7 cm.

Distr. Brazil, commonly cultivated throughout the tropics and also in subtropics (North I. of New Zealand), in the temperate zone in glass-houses since the early 19th century. Widely cultivated in Malesia.

A richly flowering ornamental, good for walls and trellis, excellent between 500–1700 m altitude, not flowering in Java below 250 m and never setting fruit. The *oranje stephanoot*, D, is easily propagated by tjankoks (marcotting) and cuttings.

Saritaea magnifica (STEEN.) DUGAND, Caldasia 3 (1945) 263, fig.; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 920, f. 31; SANTISUK, Kew Bull. 28 (1973)

184; Thai For. Bull. 8 (1974) 46; HERKLOTS, Fl. Trop. Clim. (1976) 71, f. 95. — *Arrabidaea magnifica* STEEN. Rec. Trav. Bot. Néerl. 24 (1927) 830, excl. syn. *Bignonia magnifica* BULL.; Bull. Jard. Bot. Btzig III, 10 (1928) 191; GUTTENBERG, Ann. Jard. Bot. Btzig 44 (1934) 195; CHATTERJEE, Bull. Bot. Soc. Beng. 2 (1948) 78; BACK. & BAKH. f. Fl. Java 2 (1965) 536. — *Arrabidaea* sp.: DAUBANTON, Teysmannia 29 (1918) 51–53, phot.

Pseudostipules present. Tendrils simple. Leaflets obovate, bluntly short-acuminate, 5–11 by 3–6 cm. Calyx cupular-campanulate, truncate, 6–12 by 3–7 mm. Corolla purple to magenta, 8–9 cm, the mouth white with magenta markings.

Distr. Colombia and Ecuador, widely cultivated through the tropics and common in SE. Asia and Malesia, never setting fruit. Obviously first introduced in Singapore; the Bogor Botanic Gardens received it from Banka in 1911.

A robust climber, good for walls and trellis, profusely flowering all the year round, especially in the wet season (Oct.–May), easily propagated by cuttings, found up to c. 1000 m.

Spathodea campanulata P. BEAUV. Fl. Oware Benin 1 (1805) 47, t. 27; HOOK. Bot. Mag. 85 (1859) t. 5091; SPRAGUE, Fl. Trop. Afr. 4, 2 (1906) 529; MERR. Fl. Manila (1912) 429; En. Philip. 3 (1923) 447; STEEN. Rec. Trav. Bot. Néerl. 24 (1927) 945; Bull. Jard. Bot. Btzig III, 10 (1928) 232; HOLTUM, M.A.H.A. Mag. 3 (1933) 186, fig.; IRVINE, Woody Pl. Ghana (1961) 739, t. 7; HEINE, Fl. Trop. W. Afr. ed. 2, 2 (1963) 386; BACK. & BAKH. f. Fl. Java 2 (1965) 540.

Large tree, 7–25 m, 10–50 cm Ø. Pseudostipules leafy. Leaves decussate; leaflets in (4–)5–6(–9) pairs, oblong, entire, glabrous or puberulous beneath, 5–14 by $2\frac{1}{2}$ –5 $\frac{1}{2}$ cm. Flowers erect, in terminal thyrses; calyx navicular, ribbed, beaked, thinly velutinous, 4–7 cm; corolla scarlet to orange, wide, 8–14 cm. Capsules erect, lanceolate-oblong, 15–20 by $2\frac{1}{2}$ –3 cm; valves keeled; seeds $2\frac{1}{2}$ by 2 cm, hyaline winged.

Distr. Tropical Africa; widely cultivated in the tropics in parks and as an avenue tree; throughout Malesia, up to c. 1000 m.

Vern. African tulip, Tulip tree, E, *sputjesboom*, D, *panchot*, Malaya, *djati belanda*, Kangean; Sabah: *anchit anchit*, *maundi*, Banggi.

The flowers are frequented by birds on which BEUMÉE (Trop. Natuur 14, 1925, 28–30, f. 1) did observations at Bogor. Flowers remain open for at least two days and each flower may be visited by more than one bird, obviously in search of honey. Possibly the birds play a role in pollination; corollas are frequently damaged.

AYENSU observed bats visiting the flowers at night (Ann. Mo. Bot. Gard. 61, 1974, 713).

The calyx, which is closed in bud, contains water and children play the 'waterspout' with it, hence the Dutch name. Children also use the boat-shaped valves for making small sailing boats.

Fruiting and flowering takes place throughout the year. At Bogor I found young seedlings in hedges and gardens, with a long taproot and dentate leaves, but there are no records of spontaneous naturalization. Timber is weak and worthless.

RIDLEY (Fl. Mal. Pen. 2, 1923, 547) mentioned it erroneously from Singapore under the name

S. nilotica SEEM.; although this is a closely related African tree, it is a distinct taxon characterized by a longer-tomentose, hardly ribbed calyx, leaflets tomentose underneath, a longer lobed disk and a long-hairy ovary.

Tabebuia chrysantha (JACQ.) NICHOLS. Dict. Gard. 4 (1887) 1; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 941. — *Bignonia chrysantha* JACQ. Hort. Schoenbr. 2 (1797) 45, t. 211.

Deciduous tree to 25 m, 50 cm Ø. Leaflets elliptic-oblong, abruptly acuminate, 5–25 by 4–11 cm. Calyx shallowly lobed, 5–13 mm. Corolla glabrous, tubular-infundibuliform, 5–8 cm.

Distr. Mexico to northern Venezuela, in SE. Asia cultivated, rare in Malesia (Philippines: U.S. Cemetery, Fort McKinley, Rizal Prov.). No fruit seen.

A yellow-flowered species has been reported by BACK. & BAKH. f. (Fl. Java 2, 1965, 539) to be cultivated in Java under the name *T. capitata* (BUR. & K.SCH.) SANDW., but in absence of material I cannot check the identity.

Tabebuia pallida (LINDL.) MIERS, Proc. R. Hort. Soc. 3 (1863) 199; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 950. — *Bignonia pallida* LINDL. Bot. Reg. (1826) 12, t. 695.

Shrub or small tree. Leaves 1–5-foliolate, leaflets elliptic to elliptic oblong or obovate, obtuse. Inflorescence few-flowered, often reduced to 1 or 2 flowers. Corolla pinkish lavender to almost white, the throat opening yellow.

Distr. A common variable West Indian species, closely related to *T. rosea*, cultivated in various parts of the tropics, in Indonesia distributed from Botanic Gardens, Bogor.

Tabebuia rosea (BERTOL.) DC. Prod. 9 (1845) 215; SANDW. Kew Bull. (1953) 454; GENTRY, Ann. Mo. Bot. Gard. 60 (1973) 951, with synonymy. — *Tecoma rosea* BERTOL. Fl. Guat. (1840) 25.

Deciduous tree, up to 30 m, 1 m Ø. Leaflets and petioles often unequal, lepidote, 5–30 by 2–12 cm. Calyx cupular, bilabiate, densely lepidote, $\frac{3}{4}$ –2 cm. Corolla outside glabrous, 6–10 cm.

Distr. S. Mexico to Venezuela, cultivated in the tropics in parks and along roadsides; a magnificent ornamental when abundantly flowering with blossoms in bunches on the bare twigs; not rare in SE. Asia, in Malesia only known to me from the vicinity of Manila, Luzon. No fruit seen.

Tecoma capensis (THUNB.) LINDL. Bot. Reg. 13 (1828) t. 1117. — *Bignonia capensis* THUNB. Prod. (1800) 105. — *Tecomaria capensis* (THUNB.) SPACH, Hist. Nat. Vég. 9 (1840) 137; SPRAGUE, Fl. Cap. 4, 2 (1904) 448; STEEN. Thesis (1927) 832; Bull. Jard. Bot. Btzig III, 10 (1928) 193; BRUGGEMAN, Ind. Tuinb. (1948) 39, 268 f. 273; BACK. & BAKH. f. Fl. Java 2 (1965) 538; BRUMMITT, Bull. Jard. Bot. Nat. Belg. 44 (1974) 421, f. 1 (map); HERKLOTS, Fl. Trop. Clim. (1976) 74, f. 101.

An erect and scrambling shrub, up to c. 3 m, never in my experience a true climber. Leaflets 2–4 pairs, crenate, with domatia, 1–3 by 1–2 cm. Corolla tubular, red, rarely pale yellow, 4–5 cm.

Distr. South Africa, cultivated and naturalized in many subtropical and tropical countries, e.g.

the Mediterranean; also in South America. Commonly cultivated in Java and elsewhere in Malesia, up to c. 1000 m. Flowering all the year round. No capsules seen; not run wild. Easily propagated by suckers or cuttings. A nice ornamental for gardens and often used for hedges.

BRUMMITT *l.c.* assumes that there is only one *Tecoma* (*Tecomaria*) in Africa and reduced 7 other names, distinguishing the tropical taxa as a separate race, *ssp. nyassae* (OLIV.) BRUMMITT.

In South African parks and gardens is also cultivated an even sulphur-yellow variety which was originally found in the wild, *cf.* A. JACOT-GUIL-LARMOD, Veld en Flora 4 (1974) 36; it hybridizes with the red-flowered variety and sets abundant fruit.

Tecoma capensis, the Cape Honey suckle, is bird-pollinated; *cf.* M. S. EVANS, Nature 18 (1878) 543; SCOTT-ELLIOT, Ann. Bot. 4 (1890) 270.

Tecoma stans (L.) H.B.K. Nov. Gen. Sp. 3 (1819) 144; CORNER, Wayside Trees (1940) 170, f. 44, pl. 159; BACK. & BAKH. f. Fl. Java 2 (1965) 539. — *Stenolobium stans* (L.) SEEM. Ann. Mag. Nat. Hist. 10 (1862) 30. — See for elaborate treatment p. 135.

Yellow Bells is a small, erect, ornamental shrub with showy yellow flowers.

Distr. Southern U.S.A. to southern Argentina, commonly cultivated through the tropics, in certain places naturalized. Easily propagated by seed or by suckers or cuttings. It flowers and fruits profusely in Malesia the year round, from the lowland up to c. 1000 m. Suitable for gardens and parks.

There is a form with hairy leaves (*var. velutina* DC. = *T. mollis* H.B.K.) and one with much incised leaves (*var. incisa* G. DON), the latter being naturalized in Malesia.

CRYPTERONIACEAE (R. J. van Beusekom-Osinga, Leyden)

Evergreen trees. Twigs terete to quadrangular, the younger ones mostly with four narrow ribs or wings, with thickened nodes, petiole-bases mostly connected by a faint line. *Leaves* with minute or rudimentary stipules, opposite, simple, entire, penninerved, shortly petioled, with arched or almost straight nerves mostly anastomosing in a marginal vein. *Inflorescence* terminal or axillary, sometimes below the leaves, paniculate, copiously branched to extremely depauperate, branched up to the third order, with decussate side axes which are sometimes arranged (sub-)verticillately or subumbellately by contraction, either ending in profuse to very poor racemules, or in cymoid florescences. Bracts mostly small to minute, sometimes with rudimentary stipules. *Flowers* (very) small, shortly pedicelled, bisexual, sometimes by reduction unisexual and then trees dioecious, actinomorphic, peritogynous, (4-)5(-6)-isomeric, sometimes with twice the number of stamens; receptacle widely campanulate. *Sepals* valvate, triangular to deltoid, mostly persistent. *Petals* more or less rudimentary, sometimes absent, alternisepalous, inserted on the margin of the receptacle, inflexed and enveloping the stamens, valvate, rarely imbricate, sometimes cohering, soon caducous. *Stamens* if isomeric epipetalous, (alternisepalous), inserted on the margin of the receptacle, inflexed in bud, persistent or caducous; filaments sometimes very short; connective wide, with or without a tendency to conduplication, or completely conduplicate, sometimes with a dorsal tubercle or a large outgrowth; anthers adnate, marginal or submarginal, linear to semiorbicular, lengthwise dehiscent, introrse to latrorse. *Ovary* superior or inferior, 2-4(-5)-carpellate, 1-6-locular, septa not, or rarely partly, connate; style terminal, rather long to short, \pm terete, mostly persistent; stigma capitate or punctate. *Ovules* situated in horizontal or vertical position, 1, 2, 3, or many per locule, anatropous; placentation parietal, septal, or basal. *Fruit* superior or $1/2$ - or $3/4$ -inferior, a chartaceous or woody capsule, subglobose to ellipsoid, small to big, loculicidally dehiscent with 2-6 valves, on the top often with the persistent style and stigma. *Seeds* few or many, flat, usually small, depressed-ellipsoid, situated basally, apically, centrally, or laterally in its membranous wing in which the raphe is running freely; endosperm none; embryo straight.

Distribution. Pantropical, 5 genera and 11 *spp.*, 3 genera in Indo-Malesia (of which one endemic in Borneo), one monotypic genus in S. Africa (*Rhynchocalyx*) and one in Peru and Bolivia (*Alzatea*).

Ecology. Lowland and hill tropical forest, up to 1300 (-1700) m, mostly in rain-forest, but *Crypteronia paniculata* not shunning a more or less seasonal climate.

Dactylocladus stenostachys is a characteristic peat swamp forest tree.

Young branches of *Crypteronia macrophylla* are frequently inhabited by ants.

Young foliage seems often bright coloured: in *Axinandra* innovations are mauve, while in *Crypteronia paniculata* young leaves and twigs are deep blue or violet turning pinkish brown then green (CORNER), in other species they are purplish.

Morphology. In all genera the nodes of the twigs are thickened and a characteristic transverse ridge or line, sometimes faint (absent in *Rhynchocalyx*), connects the leaf-bases. On the internodes four lengthwise raised lines or narrow wings occur, especially distinct in the upper part of young twigs; they wear off later.

The leaves offer no significant characters, but interesting is the occurrence of ephemeral rudimentary stipules which can only be observed on innovations. These are common among

Myrtalean families, but obviously absent in *Melastomataceae*, where these structures were not found in a sampling of fifteen genera.

The petals in *Crypteroniaceae* are reduced to a varying degree or are even totally absent (in *Crypteronia*). Moreover, they are always soon caducous, except in *Alzatea* where they are almost invisible and mucilaginous. In all genera they are conduplicate and enveloping the inflexed stamens as a hood. In *Dactylocladus* and *Rhynchochelys* they are minute and unguiculate; in *Axinandra* they are proportionally bigger, and have a broad instead of an unguiculate base. The petals of *Axinandra* are complicated and show a highly interesting specialization; they are coherent to connate, together having the shape of an umbrella or a mushroom. Their wide, tapering basal parts together form the awning of the umbrella, the narrow, coherent, median parts form the stem of the umbrella, and often there are wider, frayed, reflexed, apical parts of the petals together forming the handle of the umbrella (or the 'root' of the mushroom). This whole structure envelops the stamens very closely, and drops when the flower opens and the inflexed stamens stretch. It is, furthermore, interesting that these petals of *Axinandra*, depending on the species, can be valvate-connate, valvate- (or somewhat imbricate-)conduplicate, or imbricate-contorted.

Several petal characters of *Crypteroniaceae* are found again scattered in other Myrtalean families. Reduction, absence, as well as caducousness of petals occurs sporadically in almost all of these families. Unguiculate petals are more or less characteristic for *Lythraceae*, but are also found in *Sonneratiaceae* (*Duabanga*), and in *Rhizophoraceae* (e.g. *Carallia*). Connate petals with a broad base, sometimes fused to a 'cap' occur in *Myrtaceae*. Coherence of petals is also present in *Rhizophoraceae* (*Ceriops*). Valvate and imbricate petals, both found in one genus, *Axinandra*, are usually family characters in *Myrtales*. Contorted petals are, apart from *Axinandra*, only found in *Melastomataceae*.

The enveloping of the stamens by the petals in all petal-bearing *Crypteroniaceae* genera is almost unique in *Myrtales*, being only found in a few *Rhizophoraceae* (*Rhizophora* and *Bruguiera*). However, in the latter family the petals do not cover the stamens as a hood, as is the case in *Crypteroniaceae*. This is one of the characters upon which the identity of *Crypteroniaceae* as a family is based.

The stamens in *Crypteroniaceae* are arranged in one isomorous epipetalous (alternisepalous) whorl, except in *Axinandra*, where one diplostemonous whorl is present. In general number and position of the stamens in *Myrtales* can be derived from a situation with two isomorous whorls, either by reduction or by polymerisation ('dédoublement') and multiplication. Arrangement of stamens in two isomorous whorls, the diplostemonous androecium, is mostly considered to represent the basic structure of the androecium in *Myrtales*. MELCHIOR (in Engl. Syllabus 2, 1964, 345) distinguished for the androecium in *Myrtales* two progressive trends both starting from the diplostemonous androecium, viz multiplication into many stamens in many whorls and reduction towards the haplostemonous state and even eventually to 3, 2, or 1 stamen(s).

In all *Crypteroniaceae* genera the stamens are inflexed in bud. This is a widespread character in *Myrtales*, being rather typical for this order. In some families (*Myrtaceae*, *Rhizophoraceae*) it is not present in all genera, and *Lythraceae*, *Onagraceae*, and *Haloragidaceae* are the only families in which it is totally absent. The total absence of inflexed stamens in the *Lythraceae* is another fact which militates against inclusion of *Crypteroniaceae* genera in that family.

The gynoeceia of the *Crypteroniaceae* genera are distinguished by cells which are divided by interrupted septa, though these may touch each other in the centre of the gynoeceium. This (hemi)synpicate condition is very rare and assumed to be primitive within the *Myrtales*, in which it is only found in *Crypteroniaceae* and in a few genera of *Myrtaceae*.

The capsules of *Crypteronia* and *Axinandra* show interesting specialized structures with a functional significance with regard to opening and closing of the capsule. The mechanisms for this are based upon hygroscopical properties of fibres in vascular bundles.

The morphology of the seed in the *Crypteroniaceae* is peculiar. The seed-coat forms a flat, membranous wing, through which the raphe is running from the insertion to the top where it usually takes a more or less sharp turn, and runs back towards the seed proper, which either takes a central, apical, lateral, or basal position in the wing. This is another assumedly primitive character within *Myrtales*, again only found in *Crypteroniaceae* and in a few genera of *Myrtaceae*.

This character is also rare in other orders. It was first discovered in the *Trochodendraceae* and is, therefore, indicated by me as the Trochodendraceous seed type.

Summarizing, we find that almost the whole variety of floral characters in the *Crypteroniaceae* is also found scattered in other Myrtalean families. In this respect the *Crypteroniaceae* are rather heterogeneous, though not more than for instance the *Myrtaceae* and the *Melastomataceae*. On the other hand, the family is unique in the *Myrtales* by having petals enveloping the stamens as a hood. Moreover, the presence of one whorl of epipetalous (alternisepalous) stamens, characteristic for four out of the five Crypteroniaceous genera, is very rare in other Myrtalean families, being restricted to one or two genera of the *Myrtaceae* and of the *Lythraceae*, and to the monotypic *Oliniaceae*. Finally, the conduplication of the connective or the tendency to it in all *Crypteroniaceae* except *Dactylocladus*, is another important family character, in other *Myrtales* only found in a few *Melastomataceae*. Apart from the above-mentioned characters *Crypteroniaceae* are also characterized by the septation of the gynoeceum and by the Trochodendraceous seed-structure, both being only found in other *Myrtales* in a few *Myrtaceous* genera. They are, however, from a practical viewpoint, less useful for easy diagnosis. — C. F. VAN BEUSEKOM.

Taxonomy. *Crypteroniaceae* belong undoubtedly to *Myrtales*. Though the family concept in this order is fairly satisfactory, it can be observed from the above-made remarks that there are not many exclusive characters, most of them breaking down occasionally in one family, or occurring also sporadically in another family. Each family in *Myrtales* seems to be characterized by a unique character combination in addition to one or two exclusive characters.

For *Crypteroniaceae* this combination and characters are: swollen nodes with transversal line, internodes with lengthwise raised lines or wings, petals in bud hood-like enveloping the stamens, soon caducous (in *Crypteronia* absent), stamens inflexed in bud and in one epipetalous whorl (except in *Axinandra* in two whorls), absence of a perianth tube or of any space between the insertion of petals and stamens, and furthermore the presence of a (hemi)synpicate gynoeceum and seeds of the Trochodendraceous or related type, both assumedly primitive characters, and almost exclusive within *Myrtales*.

Palynological evidence does not fully sustain the recognition of *Crypteroniaceae* as a distinct family; it could be accepted, but the evidence may allow other possibilities (MULLER, *Blumea* 22, 1975, 275).

Anatomical evidence is not much in favour of the family concept as proposed; the genera could in this respect be divided up among *Melastomataceae* and *Lythraceae*, but it remains to be seen in how far anatomical characters clearly sustain other current family concepts in *Myrtales*.

Myrtales are certainly a very ancient complex and during their evolution advanced characters have evolved, reduction series occurred in more lines, and primitive characters may have incidentally persisted in various branchings of ancestral tree in taxa which are not necessarily viewed as closely related. This would also explain the 'reticulate character distribution', a condition found in several families of *Myrtales*.

None of the Myrtalean families is really homogeneous, but from this can and should not be concluded that these families are unnatural. For tracing ancestry and evolution naturalness is more important than homogeneity which, properly, increases always with decreasing taxonomic rank.

The main subdivision of two subfamilies is supported by wood-anatomical characters (VAN VLIET, *J. Micr.* 104, 1975, 65), but other anatomical characters (VAN VLIET & BAAS, *Blumea* 22, 1975, 175) and palynological data (MULLER, *l.c.*) do neither support it, nor militate against it. At tribal level morphological, anatomical and palynological data appear not to agree. The subdivision adopted here is based on morphology. — C. F. VAN BEUSEKOM.

Anatomy. VAN VLIET, *J. Microscopy* 104 (1975) 65–82 (wood anatomy and relationships); VAN VLIET & BAAS, *Blumea* 22 (1975) 175–195 (leaf, nodal and twig anatomy). These two papers contain a full bibliography to the older literature.

The anatomy of *Crypteroniaceae sensu lato* is heterogeneous. Distinctive characters are: cuticle granular (*Axinandra*, *Crypteronia*) or smooth (*Dactylocladus*); stomata paracytic (*Axinandra*, *Crypteronia*) or anomocytic (*Dactylocladus*); hypodermis present (*Axinandra*, *Crypteronia*) or absent (*Dactylocladus*); petiole with arc-shaped vascular bundle (*Axinandra*) or with \pm closed system (*Crypteronia*, *Dactylocladus*); phloem with styloid crystals (*Axinandra*, *Crypteronia*) or

crystal sand (*Dactylocladus*); cork arising in pericycle (*Axinandra*, *Crypteronia*) or subepidermal (*Dactylocladus*); node complex, with complete girdling trace (*Axinandra*, *Crypteronia paniculata*) or with common gaps (other species of *Crypteronia*, *Dactylocladus*); cortical bundles present (*Axinandra p.p.*) or absent (other taxa); vesturing of vessel pits in wood confined to the pit chamber (*Axinandra*, *Dactylocladus*) or also on pit apertures (*Crypteronia*); vessel-ray pits alternate (*Axinandra*, *Crypteronia*) or reticulate to scalariform and larger (*Dactylocladus*); parenchyma aliform with narrow wings (*Axinandra*, *Dactylocladus*) or chiefly diffuse in aggregates (*Crypteronia*); rays heterogeneous Kribs type I (*Axinandra*, *Crypteronia*) or Kribs type III (*Dactylocladus*); intercellular canal-like spaces present in rays (*Crypteronia*, *Dactylocladus*) or absent (*Axinandra*).

The entire evidence from vegetative anatomy supports affinities between *Crypteronia* and *Axinandra* — both genera sharing salient features with a number of *Melastomataceae*. *Dactylocladus* resembles several *Melastomataceae* in its anatomy more closely than it does *Axinandra* or *Crypteronia*. The inclusion of *Alzatea* from S. America and *Rhynchocalyx* from S. Africa in the *Crypteroniaceae* adds to the anatomical heterogeneity of the family. On anatomical grounds, *Rhynchocalyx* fits better in *Lythraceae*, and *Alzatea* could also be accommodated in that family with its trilacunar nodes as only aberrant character. The existence of a considerable overlap of the anatomical range in *Melastomataceae* with that of *Lythraceae*, *Sonneratiaceae* and *Oliniaceae*, forbids, however, formal taxonomic decisions on anatomical grounds only. — P. BAAS.

Palynology. Pollen grains are small, ranging in size from 11 μm in *Crypteronia paniculata* to 20 μm in *Rhynchocalyx lawsonioides*, and thin-walled with a smooth or finely verrucate outer surface. In *Alzatea* they are tricolporate, in *Axinandra*, *Dactylocladus* and *Rhynchocalyx* heterocolpate, while *Crypteronia* is characterized by bilaterally flattened bisyncolporate grains (MULLER, 1975).

The subdivision of the family according to the pollen types is not correlated with those based on morphological or anatomical characters.

The relatively unspecialized *Alzatea* type occurs in many dicotyledonous families. The heterocolpate type is found in *Combretaceae*, *Lythraceae*, *Melastomataceae*, *Oliniaceae*, and *Penaeaceae*. Pollen grains similar to the *Crypteronia* type only occur in *Cunoniaceae*, but differ in sculpture and an affinity with this family, as suggested by ERDTMAN (1952), appears remote. — References: ERDTMAN, Pollen morphology and plant taxonomy. Angiosperms. Stockholm (1952); MULLER, Note on the pollenmorphology of *Crypteroniaceae s.l.* Blumea 22 (1975) 275. — J. MULLER.

Uses. *Crypteronia paniculata*, which may attain a height of 30 m, is said to have durable, reddish heartwood and is sometimes used in West Java for house-building; also in S. Sumatra reports are favourable (HEYNE, Nutt. Pl. 1927, 1158), but occurrence is too scattered to have come into general use.

Dactylocladus stenostachys is one of the most important export timber trees of Sarawak and Sabah; see under that species.

KEY TO THE GENERA

1. Flowers sustained by 1 bract. Stamens as many as sepals; connective not or only slightly conduplicate. Capsule small, chartaceous. Seed situated (latero-)centrally in its wing. Tribe CRYPTERONIEAE.
2. Petals absent. Ovary superior with many ovules per cell. Capsule with many seeds per cell. Nerves distinct, ascending and often anastomosing into a looped marginal nerve 1. **Crypteronia**
2. Petals present, soon caducous. Ovary at least half-inferior, the lower part immersed in the receptacle, with 3 ovules per cell. Capsule with 1–3 seeds per cell. Leaves coriaceous with vague venation 2. **Dactylocladus**
1. Flowers sustained by 3 bracts, the two lateral ones often minute. Stamens twice as many as petals. Connective completely conduplicate. Ovary inferior, with 1 or 2 ovules per cell. Capsule large, woody, half-inferior. Seed situated basally in its wing. Nerves ascending and anastomosing into a looped marginal nerve. Tribe AXINANDREAE 3. **Axinandra**

1. CRYPTERONIA

BL. Bijdr. (1826) 1151; HASSK. Cat. Hort. Bog. (1844) 232 ('*Crypterhonia*'); BL. Mus. Bot. Lugd. Bat. 2 (1856) 123, t. 42; B. & H. Gen. Pl. 1 (1867) 782; DC. Prod. 16, 2 (1868) 677; CLARKE in Hook. f. Fl. Br. Ind. 2 (1879) 573; KOEHNE, Verh. Bot. Ver. Brandenburg 22 (1881) 69; O. K. Rev. Gen. Pl. 1 (1890) 250 ('*Cryptoneria*'); NIEDENZU, Bot. Jahrb. 15 (1892) 161; in E. & P. Nat. Pfl. Fam. 3, 7 (1892) 21, t. 8; HALL. f. Abh. Naturw. Ver. Hamb. 18 (1903) 90; Med. Rijksherb. 1 (1911) 31; *ibid.* 35 (1918) 17; HUTCH. Gen. Fl. Pl. 2 (1967) 33; BEUS.-OSINGA & BEUS. Blumea 22 (1975) 258. — *Henslowia* WALL. Pl. As. Rar. 3 (1831) 13, t. 221, *non* BL. 1850. — *Quilamum* BLANCO, Fl. Filip. 1 (1837) 851; ed. 2, 1 (1845) 136; ed. 3, 1 (1877) 245; *cf.* MERR. Sp. Blanc. (1918) 282. — **Fig. 1, 2, 6.**

Leaves elliptic or ovate to (ovate-)lanceolate, glabrous or slightly pubescent; midrib flat or slightly impressed above, prominent beneath; nerves ascending and often anastomosing in a looped marginal nerve, flat above, \pm prominent beneath, intramarginal nerve mostly present. *Panicles* terminal or axillary, sometimes on leafless older nodes or ramiflorous, erect to usually pendulous, poorly to rather copiously branched; axes terete to more or less angular, puberulous; racemules with very numerous flowers. Flower-bracts persistent. *Flowers* bisexual or by reduction unisexual and then trees dioecious, 4-5(-6)-isomerous, pedicelled. *Receptacle* in- and outside puberulous, inside sometimes minutely tomentose, hardly or not accrescent. *Sepals* deltoid to triangular, persistent. *Petals* absent. *Stamens* persistent, in \varnothing flowers staminodial and mostly permanently inflexed; filaments filiform, somewhat flattened, connective about orbicular, with or without a tendency to conduplication, dark when dry, anthers apically or laterally on the connective, semiorbicular to broad-linear, latrorse or \pm introrse. *Ovary* superior or almost so, the lower part adhering to the receptacle, (sub)globose to pyramidal, 2-4-carpellate, 2-4-celled, with free or only basally connate septa, badly developed in σ flowers; style filiform to subulate, somewhat longer to shorter than the ovary, more or less puberulous, persistent; stigma punctate to capitate. *Ovules* many, either in horizontal position on the septa or in \pm vertical position basally between the septa. *Capsule* superior or almost so, (sub)globose or more or less (ob)ovoid, puberulous, upper part dehiscent with 2-4 valves, inside split as far as the basal connation of the septa; valves at the top kept together by the non-dehiscent part of style and stigma. *Seeds* many, very small, in horizontal or vertical position; seed ovoid-ellipsoid, situated latero-centrally in its narrow, membranous wing, which has a shorter or longer apical and basal extension, raphe running closely along the embryo (microscopical!).

Distr. 4 spp., of which one ranges through tropical SE. Asia (Assam, Bengal, Lower Burma, Thailand, and Indo-China) to *Malesia*, the other three endemic in *Malesia*. Fig. 3.

Ecol. Lowland and montane rain-forests below c. 1300 m; *C. paniculata* also rather frequent in areas with a more or less seasonal climate. *Fl. fr.* in almost all taxa Jan.-Dec.

Uses. *C. paniculata* seems to yield a fairly good timber, but is never found in quantity.

KEY TO THE SPECIES

1. Ovary (and capsule) 2-celled with ∞ ovules *eq.* seeds on the septa. Dioecious tree: flowers by reduction unisexual, rarely bisexual. Leaves papyraceous. *Sect. Crypteronia* 1. *C. paniculata*
1. Ovary (and capsule) 3- or 4-celled with ∞ ovules (seeds) inserted basally. Flowers bisexual. Leaves usually coriaceous. *Sect. Basispermia*.

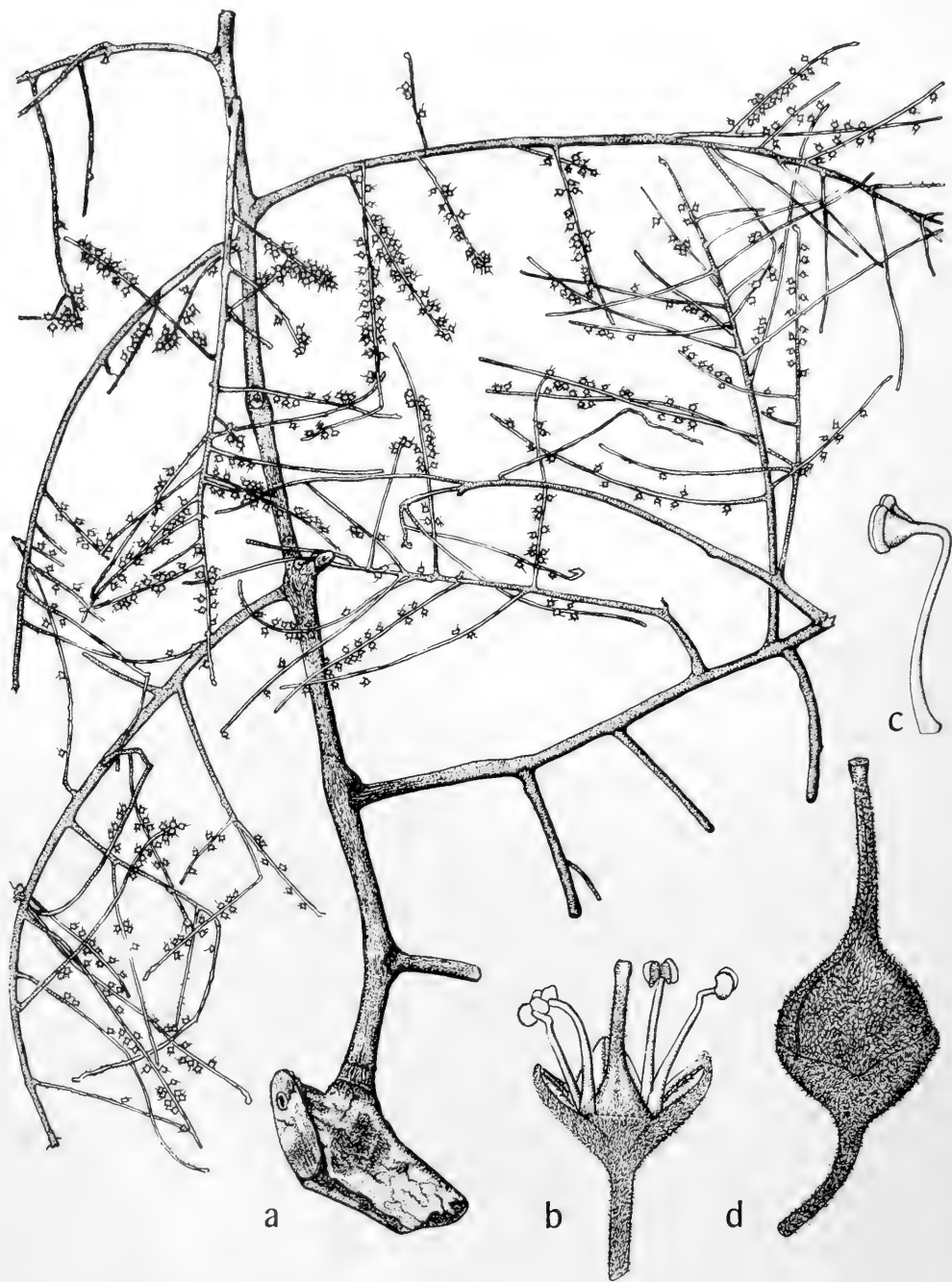


Fig. 1. *Crypteronia macrophylla* BEUS.-OSINGA. a. Inflorescence, $\times \frac{1}{2}$, b. flower, $\times 10$, c. stamen, $\times 15$, d. fruit, $\times 10$ (ASHTON S 19372).

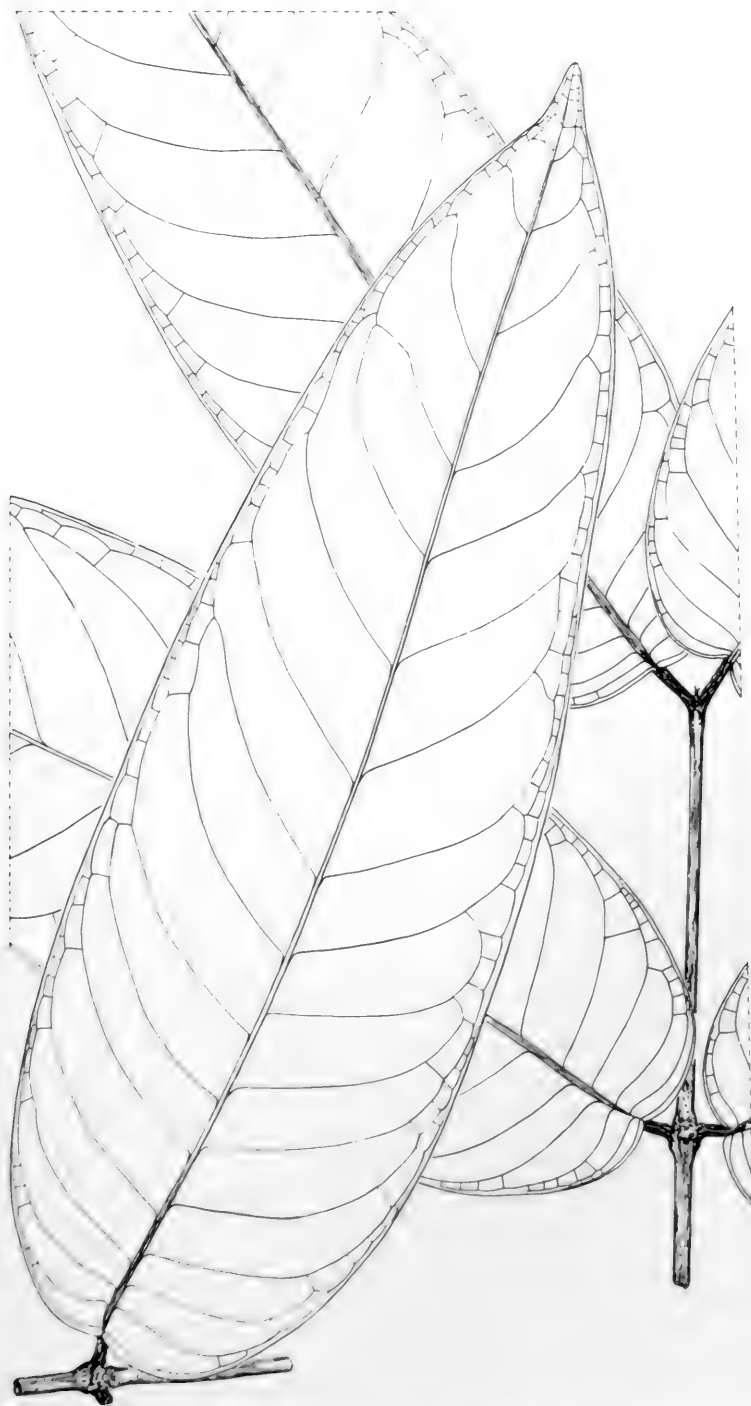


Fig. 2. *Crypteronia macrophylla* BEUS.-OSINGA. Young twig with leaves, $\times \frac{1}{3}$ (ASHTON S 19372).

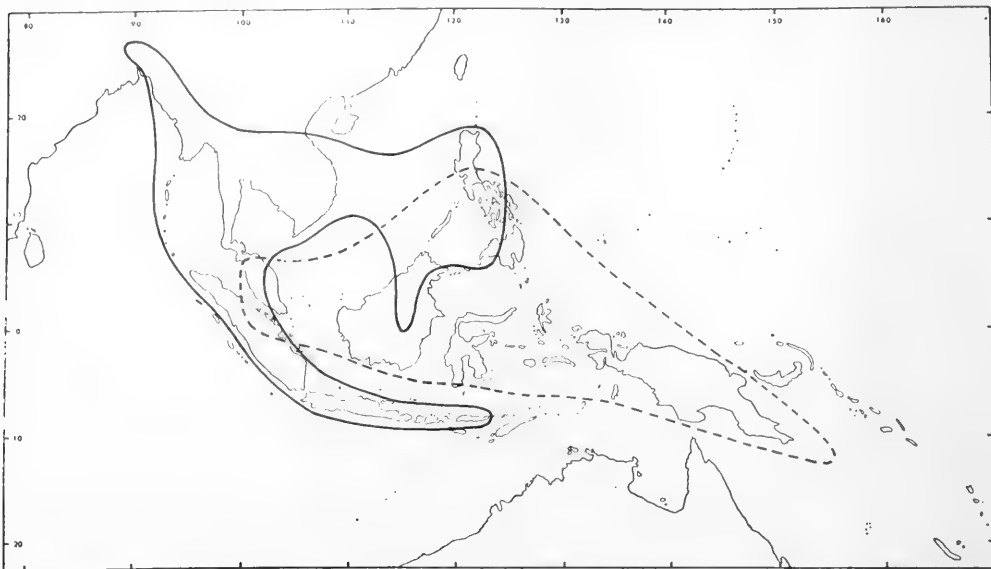


Fig. 3. Range of the genus *Crypteronia* BL.; sect. *Crypteronia* unbroken line, sect. *Basispermia* broken line.

2. Inflorescences terminal at main or side twigs, 10–25(–40) cm. Ovary (capsule) 3-locular¹. Sepals usually with longitudinal crest at the inside 2. *C. cumingii*
2. Inflorescences axillary below the leaves on older nodes, or ramiflorous, 15–90 cm. Ovary (capsule) 3- or 4-celled. Sepals with or without longitudinal crest at the inside 3. *C. griffithii*
3. Inflorescences below the leaves on older nodes, 15–50 cm, only with primary, very rarely with a few secondary side-axes near the base. Ovary (capsule) 3-celled. Sepals without crest 3. *C. griffithii*
3. Inflorescences ramiflorous, 45–90 cm², with primary, secondary and tertiary side-axes. Ovary (capsule) 4-celled. Sepals with a longitudinal crest at the inside 4. *C. macrophylla*

1. *Crypteronia paniculata* BL. Bijdr. (1826) 1151; Mus. Bot. Lugd. Bat. 2 (1856) 123, t. 42; DC. Prod. 16, 2 (1868) 679; KURZ, J. As. Soc. Beng. 46, ii (1877) 86, incl. var. *glabra* (WALL.) KURZ et var. *pubescens* (WALL.) KURZ; Fl. Burma 1 (1877) 519; CLARKE, Fl. Br. Ind. 2 (1879) 574; NIEDENZU, Bot. Jahrb. 15 (1892) 177; K. & V. Bijdr. 1 (1894) 203, incl. var. *leptostachya* (PLANCH.) K. & V.; KING, J. As. Soc. Beng. 67, ii (1898) 5; RIDL, Agr. Bull. Str. & F. M. S. n.s. 1 (1902) 180 (*Cryptorania*); MERR. Philip. J. Sc. 1 (1906) Suppl. 102; BRANDIS, Ind. Trees (1906) 341; KOORD. Exk. Fl. Java 2 (1912) 664; Atlas 2 (1914) 318; MERR. Sp. Blanc. (1918) 282; GAGNEP. & GUILLAUMIN, Fl. Gén. I.-C. 2 (1920) 696, t. 70; RIDL, Fl. Mal. Pen. 1 (1922) 821; MERR. En. Philip. 3 (1923) 140; CRAIB, Fl. Siam. En. 1 (1931) 729; OCHSE & BAKH. Ind. Groent. (1931) 182, f. 111; BURK. Dict. 1 (1935) 693; CORNER, Ways. Trees (1940) 197, pl. 48, f. 51; KRAEMER, Trees W. Pacif. Region (1951) 330; LECOMPTE, Fl. Camb. Laos & Vietn. 4 (1965) 57; BEUS.-OSINGA & BEUS. Blumea 22 (1975) 259. — *Henslowia glabra* WALL. Pl. As. Rar. 3 (1831) 14;

Cat. (1831–32) n. 4903; PLANCH. Hook. Lond. J. Bot. 4 (1845) 478; MIQ. Fl. Ind. Bat. 1, 1 (1856) 716. — *C. glabra* (WALL.) PLANCH. ex ENDL. Gen. Pl. Suppl. 4, 2 (1847) 39; BL. Mus. Bot. Lugd. Bat. 2 (1856) 123; DC. Prod. 16, 2 (1868) 678; CLARKE, Fl. Br. Ind. 2 (1879) 574; F.-VILL. Nov. App. (1880) 91; VIDAL, Sinopsis (1883) 27, t. 52, f. E; Phan. Cuming. (1885) 48; Rev. Pl. Vasc. Filip. (1886) 138. — *Henslowia pubescens* WALL. Pl. As. Rar. 3 (1831) 14, t. 221; Cat. (1831–32) n. 4904; PLANCH. Hook. Lond. J. Bot. 4 (1845) 477, t. 14 B, f. 1–4; GRIFF. Not. 4 (1854) 404; Ic. Pl. As. 4 (1854) t. 562 f. 3, t. 564 f. 2; MIQ. Fl. Ind. Bat. 1, 1 (1856) 716. — *Quilamum luteum* BLANCO, Fl. Filip. 1 (1837) 851; ed. 2, 1 (1845) 136; ed. 3, 1 (1877) 245; NIEDENZU, Bot. Jahrb. 15 (1892) 177. — *Henslowia affinis* PLANCH. Hook. Lond. J. Bot. 4 (1845) 477; MIQ. Fl. Ind. Bat. 1, 1 (1856) 716. — *Henslowia leptostachys* PLANCH. Hook. Lond. J. Bot. 4 (1845) 478; MIQ. Fl. Ind. Bat. 1, 1 (1856) 716. — *Henslowia hookeri* WALL. Cat. (1847) n. 8566, nomen. — *C. affinis* (PLANCH.) PLANCH. ex ENDL. Gen. Pl. Suppl. 4, 2 (1847) 39. — *C.*

(1) Rarely a few 4-locular ovaries may be found among the predominant 3-locular ones in one inflorescence.

(2) One should be aware that of the big inflorescences of *C. macrophylla* usually only fragments have been collected.

pubescens (WALL.) PLANCH. ex. ENDL. l.c.; BL. Mus. Bot. Lugd. Bat. 2 (1856) 123; DC. Prod. 16, 2 (1868) 678, incl. var. *affinis* (PLANCH.) DC.; CLARKE, Fl. Br. Ind. 2 (1879) 574, incl. var. *hookeri* (WALL. ex DC.) CLARKE; F.-VILL. Nov. App. (1880) 91; NIEDENZU, Bot. Jahrb. 15 (1892) 176, incl. var. *typica*. — *C. leptostachys* (PLANCH.) PLANCH. ex ENDL. Gen. Pl. Suppl. 4, 2 (1847) 39; BL. Mus. Bot. Lugd. Bat. 2 (1856) 123; DC. Prod. 16, 2 (1868) 679; BAILL. Hist. Pl. 6 (1877) 436, f. 414, 415 ('*leptostachya*'); VIDAL, Phan. Cuming. (1885) 53; Rev. Pl. Vasc. Filip. (1886) 139; NIEDENZU, Bot. Jahrb. 15 (1892) 175; MERR. En. Philip. 3 (1923) 140. — *Henslowia paniculata* (BL.) MIQ. Fl. Ind. Bat. 1, 1 (1856) 716. — *C. lutea* (BLANCO) BL. Mus. Bot. Lugd. Bat. 2 (1856) 123; DC. Prod. 16, 2 (1868) 679. — *C. hookeri* WALL. ex DC. l.c. — *C. wallichii* DC. l.c.; HANCE, J. Bot. 14 (1876) 259.

Tree up to c. 30 m. Twigs glabrous or puberulous. Leaves elliptic or oblong or ovate-oblong, (5-)10-15(-25) by (3-)5-10(-12) cm, rounded to cuneate at the base, acuminate to cuspidate at the top, tip usually obtuse, sometimes acute, glabrous or puberulous, chartaceous to herbaceous, usually finely and distinctly reticulate beneath; nerves 8-10(-12) pairs; petiole 5-10 mm, 1-2 mm \varnothing , glabrous or puberulous. Panicle axillary or terminal, also on leafless older nodes, (5-)10-30 cm, branched up to the second order, without definite peduncle, more or less pendulous, not woody; main axis more or less angular; primary axes 2-5 pairs, the lower ones usually with 1-3 pairs of 5-25 cm long racemes. Bracts of axes triangular or narrowly triangular, 1-6 mm, usually caducous. Bracts of the flowers narrowly triangular to linear, $\frac{1}{2}$ -1 mm, persistent. Pedicels 1-3 mm, c. $\frac{1}{4}$ mm \varnothing . Receptacle c. $\frac{1}{2}$ mm high, c. 2 mm wide, puberulous, inside sometimes minutely tomentose. Sepals deltoid to triangular, ($\frac{1}{4}$ -) $\frac{1}{2}$ -1 $\frac{1}{4}$ mm. Stamens

5 (4), reduced and mostly permanently inflexed in \varnothing flowers; filaments $2\frac{1}{2}$ -3 $\frac{1}{2}$ mm, glabrous; connective c. $\frac{1}{2}$ (- $\frac{3}{4}$) mm, not conduplicate; anthers linear, $\frac{1}{4}$ - $\frac{1}{2}$ by c. $\frac{1}{4}$ mm, latrorse. Ovary reduced in \varnothing flowers, subglobose, 2(-3)-locular, 1-2 mm, puberulous; style 1-2 mm, c. $\frac{1}{4}$ mm \varnothing , puberulous; stigma capitate, c. $\frac{1}{4}$ mm. Ovules inserted on the surface of the septa. Capsule (sub)globose or more or less obovoid, 2-3 mm, usually recurved; valves 2, rarely 3. Seeds $\frac{1}{2}$ -1 by c. $\frac{1}{4}$ mm; acute apical part of the wing half as long as the seed proper, basal part mostly short.

Distr. Continental SE. Asia (Assam: Khasya Hills, Sylhet, Lushai Hills; Bengal: Burma: Arakan Div. to Rangoon; S. Indo-China) and West Malesia: eastwards to the Philippines, Borneo, and Flores. Fig. 4.

Note. Two replacing varieties are distinguished but it should be mentioned that in Penang and in the Rangoon area, where the ranges coincide, more or less intermediate specimens are found which have almost or practically glabrous leaves and twigs.

KEY TO THE VARIETIES

1. Leaves and branches glabrous. Receptacle inside more or less puberulous. Sepals c. 1 mm long. Capsules (sub)globose . var. **paniculata**
1. Leaves at least beneath, and young twigs puberulous. Receptacle inside tomentose. Sepals $\frac{1}{4}$ - $\frac{1}{2}$ (- $\frac{3}{4}$) mm long. Capsules (sub)globose to obovoid var. **affinis**

var. **paniculata**. — *C. paniculata*, incl. var. *glabra* et var. *leptostachya* — *C. glabra* — *Quilamum luteum* — *C. leptostachys* — *C. lutea* — *C. wallichii*.

Leaves (5-)10-15(-25) by (3-)5-10(-12) cm, glabrous; petiole glabrous. Buds glabrous. Inflorescence up to c. 30 cm; racemes up to 25 cm. Receptacle inside puberulous. Sepals c. 1 mm long. Stamens $\frac{1}{2}$ -1 mm long. Capsule (sub)globose.

Distr. Continental SE. Asia: E. Bengal (Chittagong), Assam (Khasia Hills, Lushai Hills), Andaman Is., Burma (Arakan, Rangoon, Pegu, Tenasserim); in Malesia: Malay Peninsula (Kedah, Perak, Langkawi I., Pahang, Selangor, incl. Penang I.), Sumatra (Sibolangit, Pajakumbuh, Painan, Palembang), Java, Lesser Sunda Is. (Bali, Sumbawa, Flores), Borneo (Sabah, W. Kutai), Philippines. Fig. 4.

Ecol. Primary and secondary forests on hills and mountains up to 1700 m. Reported from riverbanks, ridges, ravines and forest borders. Scattered, locally fairly common.

Field notes. Bole up to 15 m, often crooked. Buttresses sometimes present. Bark smooth or rough, scaling off. Young twigs and leaves deep blue or violet (CORNER), when dried blackish. Flowers white, pale green, or greenish yellow.

Uses. The timber is reported as of good quality, used amongst others for house-building purposes and cart-wheels. In the Philippines the bark is sometimes used against skin-eruptions. In Java the young shoots are eaten with rice as lalab (HASS-KARL).

Vern. Sumatra: *kayu kapas*, *mëdang ajam*, M; Malaya: *bëkoi*, *bëkwoi*, *berkol*, *bua babi*, *mëkuah*, *rupal*, *tukoi*, M; Java: *kibanèn*, *kitjèngklak*, S, *kayu babi*, *kigandik*, *ponggonan* (Jakarta, M),

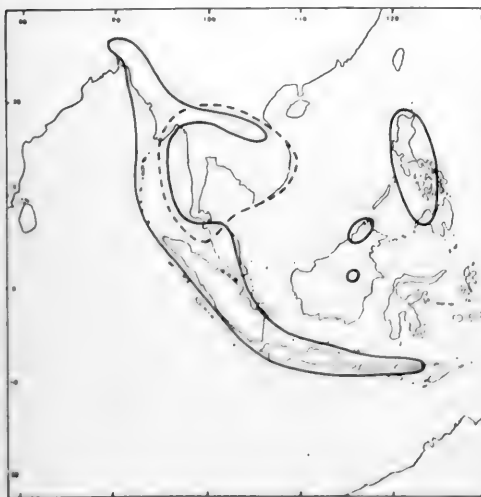


Fig. 4. Range of *Crypteronia paniculata* BL. var. *paniculata* (unbroken line) and var. *affinis* (PLANCH.) BEUS.-OSINGA (broken line).

kibakko, *kidjarak* (Priangan), *bang-kongan* (Banten), *blis* or *blisan*, *kayu tjèlèng* (Banjumas), *mungur* (Madiun), *wungu lubu* (Kediri), *tjèleng(an)*, *wrakas* or *kwakas* (Pekalongan), *glingsing* (Pasuruan), *sèpat* (Besuki), all J; Flores: *madja*; Sumbawa: *sarowe*; Borneo: *kinkidon mantok*, Dusun; Philippines: *balinog*, *bitog*, *bitok*, *bongari*, *bongau*, *bungaing*, *kilamo*, *malabaydnas*, *salasan*, *tiaui*, *tua*, Tag., *agidai*, *agudai*, *barabok*, *barakbak*, *bungaing*, Ilk., *banujo*, *tolan-manók*, P.Bis., *baroga*, *baruga*, *kodai*, *kudai*, *ladao*, Ig., *kamanok*, Bis., *malabiong*, Sbl.

var. affinis (PLANCH.) BEUS.-OSINGA, *comb. nov.* — *Henslowia affinis* PLANCH. Hook. Lond. J. Bot. 4 (1845) 477. — *C. affinis* — *C. pubescens*, *incl. var. affinis* (PLANCH.) DC. Prod. 16, 2 (1868) 678. — *C. hookeri*.

Leaves (2)–5–10(–16) by (1½)–3–6(–8) cm, sometimes sparsely puberulous above, more or less puberulous beneath especially on the nerves; petiole puberulous. Buds puberulous. Inflorescence up to c. 20 cm; racemes up to 20 cm. Receptacle inside tomentose. Sepals ¼–½(–¾) mm long. Stamens 0.1–0.3 mm long. Capsule (sub)globose to obovoid.

Distr. Continental SE. Asia: Burma (Rangoon, Pegu, Tenasserim Div.), Thailand, Laos, Cambodia, S. Vietnam; in *Malesia*: Malaya (Kedah; Penang I.). Fig. 4.

Ecol. Several times reported from riverbanks and ridges, 90–300 m.

2. *Crypteronia cumingii* (PLANCH.) PLANCH. ex ENDL. Gen. Pl. Suppl. 4, 2 (1847) 39; BL. Mus. Bot. Lugd. Bat. 2 (1856) 123; DC. Prod. 16, 2 (1868) 678; F.-VILL. Nov. App. (1880) 91; VIDAL, Phan. Cuming. (1885) 20; Rev. Pl. Vasc. Filip. (1886) 138; NIEDENZU, Bot. Jahrb. 15 (1892) 179; MERR. Philip. J. Sc. 1 (1906) Suppl. 102; En. Philip. 3 (1923) 139; MERR. & PERRY, J. Arn. Arb. 12 (1941) 270. — *Henslowia cumingii* PLANCH. Hook. Lond. J. Bot. 4 (1845) 478, t. 14, f. C 1–4. — *C. javanica* BAILL. Hist. Pl. 6 (1877) 435, f. 412, 413, *nomen*. — *C. laxa* ELMER, *nomen in sched.*, cf. MERR. En. Philip. 3 (1923) 140.

Tree up to 40 m. Twigs glabrous. Leaves elliptic to ovate-oblong, (5)–8–25 by (3)–4–14 cm, usually emarginate sometimes rounded or acute at the base, acute, sometimes acuminate at the top, tip mostly obtuse, glabrous, coriaceous, distinctly and slightly prominently reticulate beneath; nerves 6–12(–15) pairs; petiole 2–10(–15) mm, 1–4 mm Ø, glabrous. Inflorescence terminal, at the end of main or side twigs, 10–25(–35) cm, branched up to the first, second or third order, whether or not peduncled, erect, with flaccid to stiff and subliguose axes; main axis more or less flattened; primary axes 5–25, paired or irregular, sometimes in whorls of 4; racemes up to 15 cm. Bracts of axes triangular, 2–10 mm, sometimes present as small or reduced leaves, persistent or caducous. Bracts of flowers narrowly triangular, ½–1½ mm, persistent. Pedicels 1½–2 mm, c. ½ mm Ø. Receptacle ½–1¼ mm high, 1½–2½ mm wide, densely whitish papillose inside. Sepals 5, triangular, 1–1¼(–1½) mm, inside mostly with a longitudinal densely puberulous crest. Stamens 5; filaments 1–2½ mm, glabrous; connective c. ¼ mm, slightly conduplicate;

anthers linear or semiorbicular, c. ¼(–½) by 0.1–0.2 mm, ± latrorse. Ovary subglobose, 3-celled, 1–1½ mm, whitish papillose and/or puberulous; style (1)–1½–2½ mm, 0.2–0.4 mm Ø, more or less shortly puberulous to papillose; stigma punctate to slightly capitate. Ovules inserted on the somewhat conically elevated edges between the bases of the sepals. Capsule (sub)globose, more or less episeptally impressed, c. 2 mm; valves 3. Seeds c. ¾ by c. ¼ mm, apical and basal part of wing from ½ to 1 times as long as the seed proper.

Distr. *Malesia*: Borneo (Sarawak), Philippines (Luzon), Celebes, Moluccas (Morotai, Halmahera), New Guinea (incl. Misool and Louisiades: Rossel I.). Fig. 5.

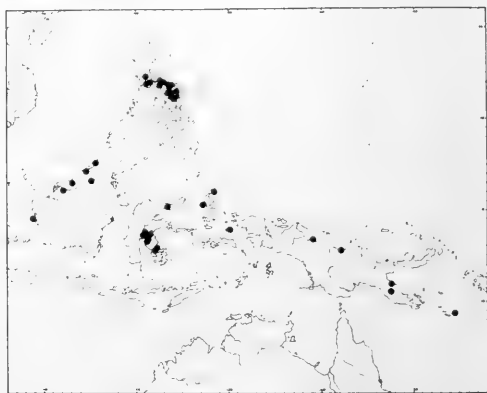


Fig. 5. Range of *Crypteronia cumingii* (PLANCH.) PLANCH. ex ENDL.

Ecol. Primary and secondary forests, on ridges, slopes, and along riverbanks, usually at low altitude, but also in the hills to 1200 m, once even found at 1800 m (Central Celebes, Malili area: B. Takale Kadju).

Vern. Borneo: *ubah*, Iban, Sarawak; Philippines: *andalai*, Tag., *ugáu*, *tigáuon*, Bik.; Central Celebes, Malili area: *kumba-a*, *langori tauru*, *longari*, *tomo wanna*.

Notes. As appears from his drawings, *C. javanica* BAILL. must be referred here: bisexual flower with basal ovules; very probably they were made after a Philippine specimen.

In a depauperate collection from New Guinea (NGF 2958) the panicles are axillary.

In specimens from the Moluccas frequently 6-merous flowers occur among the normally 5-merous ones.

In specimens from New Guinea there are usually some 4-celled ovaries and 4-celled fruits present among the predominantly 3-celled ones.

3. *Crypteronia griffithii* CLARKE in Hook. f. Fl. Br. Ind. 2 (1879) 574; KING, J. As. Soc. Beng. 67, ii (1898) 5; RIDL. Agr. Bull. Str. & F. M. S. n.s. 1 (1902) 180; Fl. Mal. Pen. 1 (1922) 821; WATSON, Mal. For. Rec. 5 (1928) 176; BURK. Dict. 1 (1935) 693; CORNER, Ways. Trees (1940) 198. — *Henslowia sp.*, GRIFF. Not. 4 (1845) 404; Ic. Pl. As. 4 (1845) t. 564, f. 1. — Fig. 6.

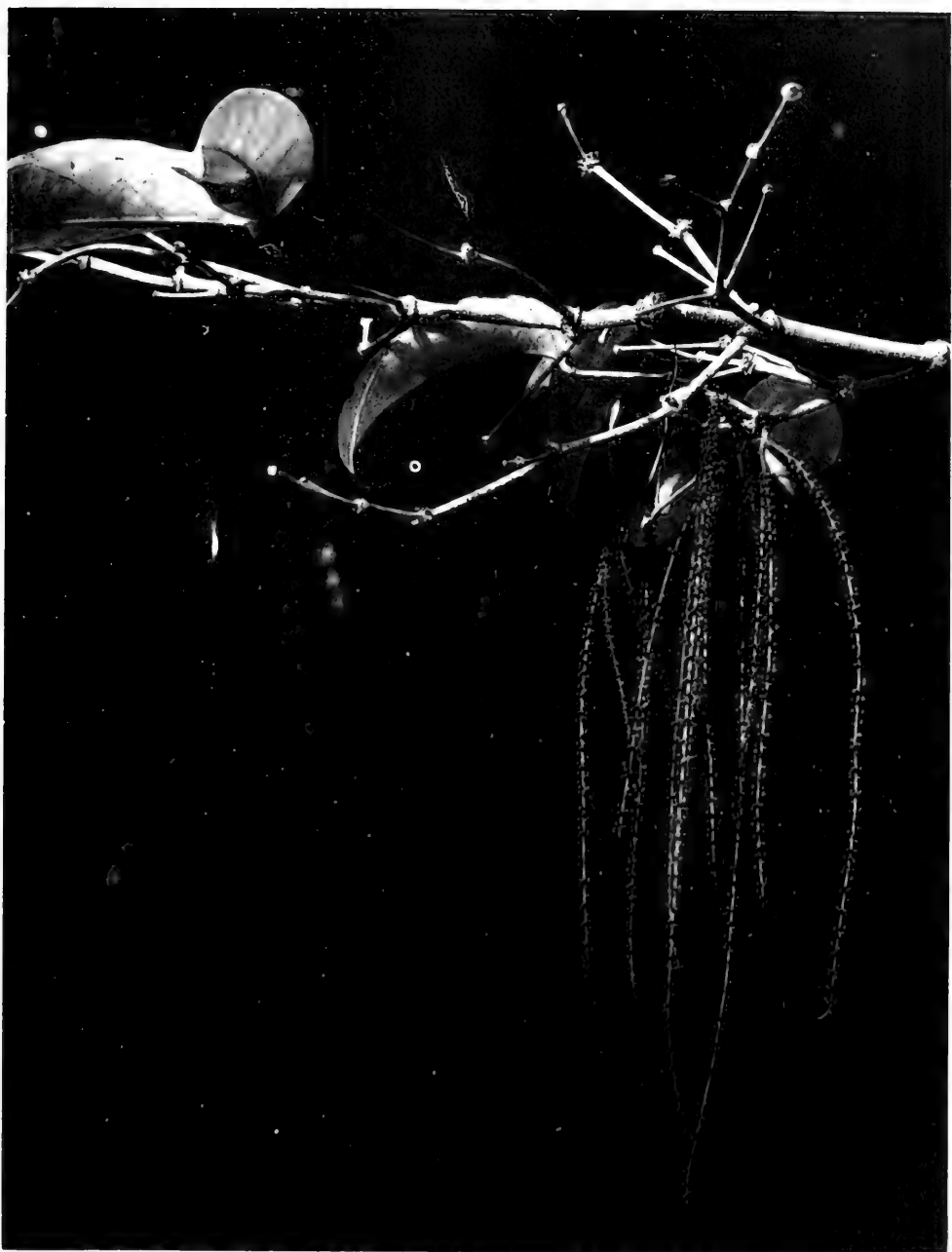


Fig. 6. *Crypteronia griffithii* CLARKI, Singapore watercatchment area, Dec. 1969 (Photogr. VAN BEUSEKOM).

Tree up to 40 m, 60 cm Ø. Twigs glabrous. *Leaves* elliptic-oblong to ovate-oblong, (5-)10-25 (-35) by 5-12(-15) cm, rounded or emarginate at the base, acute, sometimes acuminate at the top, tip usually obtuse, sometimes acute, glabrous, coriaceous, distinctly and slightly prominently reticulate beneath; nerves (8-)10-15(-18) pairs; petiole (2-)5-10 mm, 2-5 mm Ø, glabrous. *Inflorescence* axillary, one or a few together below the leaves on older nodes, 15-50 cm, only with primary side axes, very rarely with a few secondary side axes near the base, without distinct peduncle, subligulate, often ferruginously pubescent, with pendulous axes; main axis terete or somewhat flattened, finely ribbed; primary axes 8-12(-15), not always paired, finely ribbed; racemes up to 50 cm. Bracts of axes triangular, c. 1 mm, mostly caducous. Bracts of flowers subulate, c. 1 mm, persistent. Pedicels $\frac{1}{2}$ -1(- $\frac{1}{2}$) mm, c. $\frac{1}{2}$ mm Ø. *Receptacle* c. 1 mm high, 2-3 mm wide, densely whitish papillose inside. *Sepals* triangular, $1\frac{1}{2}$ -2 mm. *Stamens* 5; filaments 3-4 mm, glabrous; connective $\frac{1}{4}$ - $\frac{1}{2}$ mm, slightly conduplicate; anthers linear, $\frac{1}{4}$ - $\frac{1}{2}$ by c. 0.1 mm, \pm latrorse. *Ovary* (sub)globose to pyramidal, 3-celled, c. 1 mm, more or less fine whitish papillose whether or not with longer hairs in between; style ($1\frac{1}{2}$ -3-4(-5) mm, c. $\frac{1}{4}$ mm Ø, sparsely puberulous; stigma slightly capitate. *Ovules* inserted on the somewhat conically elevated edges between the bases of the septa. *Capsule* (sub)globose, c. 2 mm; valves 3. *Seeds* 0.3-0.4 by c. 0.2 mm, apical and basal part of wing about $1\frac{1}{2}$ times as long as the seed proper.

Distr. Burma (Moulmein, one coll.); in *Malesia*: Central Sumatra (one coll.), Malay Peninsula (incl. Penang I.), Borneo (W. Sarawak, Sandakan, Gaya I., E. Kutai, Nunukan I.). Fig. 7.

Ecol. In primary lowland forests, often on sandy soils, up to 500 m.

Field notes. Bole usually straight. Bark surface

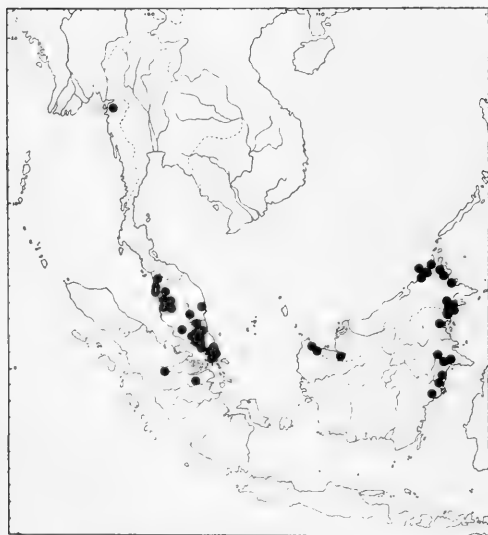


Fig. 7. Range of *Crypteronia griffithii* CLARKE.

smooth or rough and scaly. Twigs strongly swollen at the nodes. Young leaves purplish. Flowers dark blue to purple or magenta, sometimes noted yellow or yellowish reddish.

U ses. RIDLEY (1902) reported the wood to be durable and used for house-building.

Vern. Sumatra: *panarahan*; Malay Peninsula: *békwoi*, *kélat tampoi*, *nyirék bukit*, *sémpo*, *sérumpu*, *simpoh*, *sumpu(t)*, *télinga badak*; Borneo: *engkolot*, *rambai rambai*, Gaya I., *ubah sémut*, Iban.

4. *Crypteronia macrophylla* BEUS.-OSINGA, *Blumea* 22 (1975) 261. — Fig. 1, 2.

Tree up to 20 (?) m. Twigs glabrous. *Leaves* ovate-oblong to lanceolate, (20-)25-45 by 7-15 cm, usually emarginate, sometimes rounded at the base, acute to \pm acuminate at the top, tip obtuse, glabrous, coriaceous, distinctly and \pm prominently reticulate beneath; nerves 15-25 pairs; petiole 5-10(-15) mm, 2-5 mm Ø, glabrous. *Inflorescence* ramiflorous, 45-90 cm, always branched up to the third order, without distinct peduncle, pendulous, woody, with spreading axes; main axis terete; primary axes many, not always paired; racemes up to 30 cm. Bracts of axes triangular, c. 1 mm, caducous. Bracts of the flowers subulate, c. 1 mm, persistent. Pedicels 1-3 mm, c. $\frac{1}{2}$ mm Ø. *Receptacle* \pm flat, 1- $1\frac{1}{2}$ mm wide, puberulous, not densely papillose inside. *Sepals* deltoid, c. 1 mm, inside with a longitudinal densely puberulous crest. *Stamens* 4; filaments $1\frac{1}{2}$ -3 mm, glabrous, at the very base puberulous; connective c. $\frac{1}{2}$ mm, more or less conduplicate; anthers \pm linear, $\frac{1}{2}$ by 0.1-0.2 mm, \pm introrse. *Ovary* pyramidal, 4-celled, 1-2 mm, puberulous, more or less episepally impressed; style (1-) $1\frac{1}{2}$ -2($\frac{1}{2}$ -3) mm, c. $\frac{1}{4}$ mm Ø, puberulous; stigma truncate, hardly wider than the style. *Ovules* inserted on the somewhat conically elevated edges between the bases of the septa. *Capsule* (sub)globose to pyramidal, 2-2 $\frac{1}{2}$ by 2-2 $\frac{1}{2}$ mm; valves 4. *Seeds* c. $\frac{1}{2}$ by c. $\frac{1}{4}$ mm, apical and basal part of wing as long as or slightly longer than the seed proper.

Distr. *Malesia*: Borneo: Sarawak (Kuching, Sibul), Kutai (several localities), Sambas region. Fig. 8.

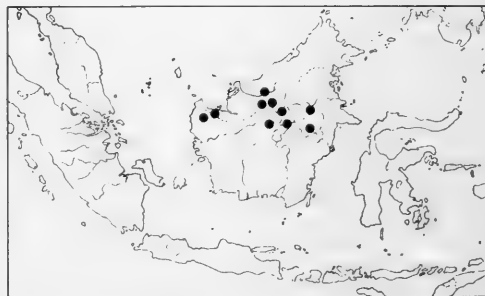


Fig. 8. Range of *Crypteronia macrophylla* BEUS.-OSINGA.

Ecol. In primary forest up to 1200 m. Locally frequent. Young branches are often inhabited by ants.

Field notes. Tree with semi-pendent branches. Bark surface smooth. Young leaves rich purplish. Flowers greenish with purple-brown stamens. Fruits dark green.

Note. The large, complex, woody inflorescence which is always produced below the leaves on older nodes is characteristic.

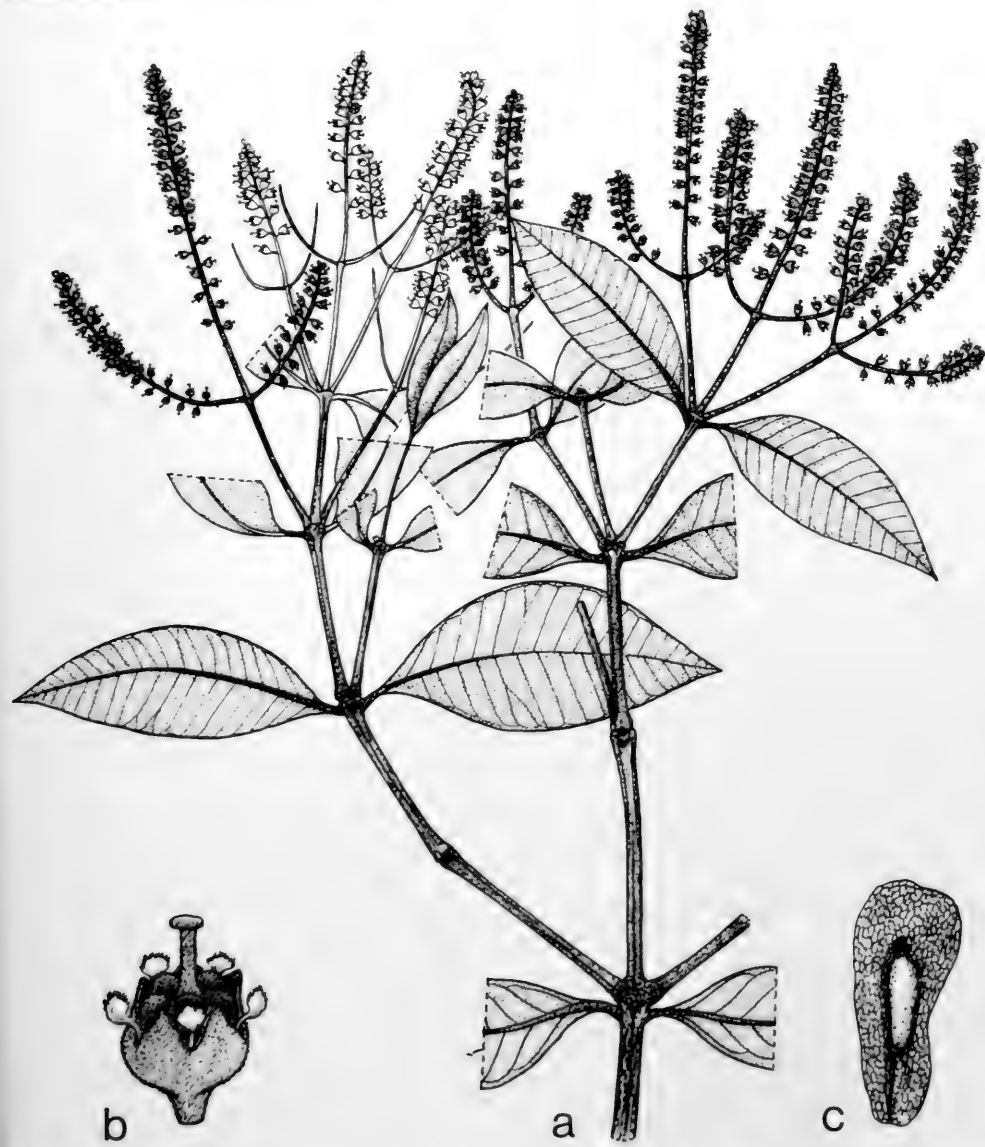


Fig. 9. *Dactylocladus stenostachys* OLIV. a. Habit, $\times \frac{2}{3}$, b. flower, $\times 10$, c. seed, $\times 16$ (a, b FUCHS 21186, c S 9261).

2. DACTYLOCLADUS

OLIV. in Hook. Ic. Pl. (1895) t. 2351; GILG in E. & P. Nat. Pfl. Fam. Nachtr. 1 (1897) 267; HALL. f. Med. Rijksherb. 35 (1918) 18; BAKH. f. Rec. Trav. Bot.

Néerl. 40 (1943) preprint 329; BEUS.-OSINGA & BEUS. *Blumea* 22 (1975) 261. — **Fig. 9.**

Leaves elliptic or obovate to (obovate-)oblong, glabrous; midrib thickish, \pm flat above, prominent beneath; nerves \pm straight, anastomosing in an indistinct marginal nerve. *Inflorescence* terminal or axillary to the highest leaves, erect, poorly branched; axes flattened, puberulous; racemules with at least a few tens of flowers. Flower-bracts caducous. *Flowers* bisexual, 5-(4-)isomerous, almost sessile. *Receptacle* in- and outside puberulous, accrescent. *Sepals* triangular, persistent. *Petals* unguiculate, with suborbicular, irregularly lobed lamina, in bud covering the stamens as a hood, soon caducous. *Stamens* persistent; filaments terete, somewhat flattened; connective about orbicular, not conduplicate; anthers inserted transversally, somewhat below the upper margin of the connective, oblong to broad-linear, introrse. *Ovary* half-inferior, the lower part adnate to the receptacle, the top part semiglobose, puberulous, (3-), 4- or 5-carpellate, (3-), 4- or 5-locular, septa not connate; style subulate, somewhat longer than the ovary, puberulous, persistent; stigma capitate. *Ovules* 3 per locule, inserted in vertical position, basally between the septa. *Capsule* almost inferior, broad-ellipsoid, small, pericarp chartaceous, puberulous, inside dehiscent down to the bottom with (3) 4 or 5 valves of which only the upper $\frac{1}{4}$ protrudes from that part of the pericarp that is surrounded by and fused with the enlarged receptacle, at the top often kept together by the non-splitting stigma. *Seeds* 3 per locule (1 or 2 sometimes not developed), small, in vertical position; seed narrow-ellipsoid, flat, situated centrally in its more or less rectangular, narrow, membranous wing almost 2 times as long as the body of the seed; raphe running close to the embryo.

Distr. *Malesia*: Borneo and W. New Guinea (sterile coll.). **Fig. 10.**
Ecol. Lowland peat swamp forest.

1. *Dactylocladus stenostachys* OLIV. in Hook. Ic. Pl. IV, 4 (1895) t. 2351; HALL. f. Med. Rijksherb. 35 (1918) 18; MERR. En. Born. (1921) 452; DIELS & HACKENBERG, Bot. Jahrb. 60 (1926) 312; BAKH. f. Rec. Trav. Bot. Néerl. 40 (1943) preprint 329; BROWNE, For. Trees Sarawak & Brunei (1955) 261, t. 33; ANDERSON, Gard. Bull. Sing. 20 (1963) 178, pl. 1, 2, 6, 7; MEIJER, Field Guide Trees W. Mal. (1974) 205, f. 51, pl. 14; BEUS.-OSINGA & BEUS. *Blumea* 22 (1975) 262. — **Fig. 9.**

Tree up to 40 m, dbh up to $1\frac{1}{4}$ m, at the base producing pneumatophores. Twigs often several together per leaf-axil, the younger ones often with ribbed angles. *Leaves* 4-8(-16) by $2\frac{1}{2}$ -4(-6) cm, with revolute margin, cuneate at the base, sometimes emarginate, usually rounded up to acuminate at the top with acute tip, coriaceous; nerves 11-15 pairs, usually rather obscure, flat to prominent above and beneath; petiole 3-5 mm, 2-3 mm \varnothing . *Inflorescence* when axillary 1-3 together, erect, up to 14 cm, consisting of 3 racemules; peduncle up to 6 cm, (sub)glabrous; axes finely ribbed; racemules c. 8 cm, from 1 cm above the base \pm densely set with flowers. Bracts of axes minute, soon caducous. Bracts of the flowers linear or narrowly triangular, c. 1 mm. Pedicels up to $\frac{1}{2}$ mm. *Receptacle* c. 2 mm high, c. $2\frac{1}{2}$ mm wide. *Sepals* c. 1 mm. *Petals* c. 1 mm, puberulous outside and

on the margin. *Filaments* c. 1 mm, 0.2 mm wide, puberulous; connective $\frac{1}{4}$ - $\frac{1}{2}$ mm; anthers 0.2 by 0.1 mm. *Style* $1\frac{1}{2}$ -2 mm, c. 0.2 mm \varnothing ; stigma $\frac{1}{4}$ - $\frac{1}{2}$ mm. *Capsule* 3-4 by 2-3(- $3\frac{1}{2}$) mm. *Seed* c. 1.4 by 0.2-0.3 mm, including wing $2\frac{1}{2}$ -3 by $\frac{3}{4}$ - $1\frac{1}{4}$ mm.

Distr. *Malesia*: widely distributed in Borneo. It was by error incidentally reported from Malaya (Fl. Mal. Bull. p. 1696, p. 2375). **Fig. 10.**

Ecol. DURANT (For. Rep. Brunei, 1933, 6, photogr.) reported this species (under the name *Crypteronia*) to occur in Brunei as an associate of



Fig. 10. Range of the genus *Dactylocladus* OLIV.; *D. stenostachys* OLIV. dots, *D. sp.* triangle.

Dryobalanops and *Combretocarpus* in considerable quantity over large areas of freshwater swamp, often with 12 mature trees (over 30 cm Ø) per ha. DIELS & HACKENBERG (*l.c.*) mentioned its occurrence in the Sampit swamp forest area in SW. Borneo together with *Combretocarpus*, *Campnosperma*, etc. BROWNE (*l.c.*) stated that it occurs in practically all types of peat swamp forest in Sarawak. He found its frequency somewhat lower than DURANT did; he found sometimes 8, but averagely 3 mature trees per ha, but he said that locally, between Balingian and Bintulu, it was the dominant tree of the swamps of Sarawak.

BROWNE recorded that the vernacular names *jongkong* and *tabak* allude to characteristic qualities: *jongkong* referring to the rather stout yellowish pneumatophores at the stem-base, while *tabak* would refer to the characteristic minute perforations of the wood from radial vessels.

ANDERSON (*l.c.*) confirmed BROWNE's observation that it is one of the most characteristic swamp forest trees, the only species represented in all communities throughout Sarawak and Brunei. He produced photographs of the *Gonystylus-Dactylocladus-Neoscortechinia* (*l.c.* pl. 1 & 2) and the *Combretocarpus-Dactylocladus* associations (*l.c.* pl. 6 & 7).

Its wide range in the peat swamps is also confirmed palynologically in the peat according to ANDERSON & MULLER (Rev. Palaeobot. & Palyn. 19, 1975, 314-316) where it figures in phases 1-6. In a Miocene deposit in Brunei, near Berakas, MULLER reported also its occurrence (*l.c.* f. 5, diagram) with the associates as today. It must be added that its pollen can be confused with that of *Axinandra* and some *Melastomataceae* of which the latter also occur in peat swamps, albeit in small numbers.

It is remarkable that whereas this type of peat forest ranged unbrokenly at least from the Miocene to the Present, *Dactylocladus* is not yet found in Sumatra and Malaya, provinces with which Borneo was joined, during the Pleistocene Glacial period, by a huge lowland riverine area (now the South China Sea); this would have made dispersal and exchange very probable, as it was for its associate *Combretocarpus* and some species of

Gonystylus. It may yet be discovered in the peat swamps of Malaya and Sumatra, but must then be very rare.

Uses. According to BROWNE (*l.c.*) it is the fourth important export timber tree of Sarawak. Extraction is facilitated by the fact that the logs float in water. MEIJER (*l.c.*) termed it a general utility timber in Sabah where it is, besides *Gonystylus*, the most important export timber from the Klias Peninsula.

Vern. *Jongkong*, *tabak* (the most common names), *ëntibu*, *garu buaja*, *jinjang*, (*mědang*) *běladi*, *m. miang*, *mělinkat kěrangas*, *měřëbong*, *těřënjangan*.

Dactylocladus sp. — Cf. MEIJER, Field Guide Trees W. Mal. (1974) 205, in note.

Distr. *Malesia*: West New Guinea: in peat forest along Rouffaer R., the only large tree in this forest type, c. 175 m alt., DOCTERS VAN LEEUWEN 9973 (BO, L, etc.), sterile, distributed as *Memecylon* sp. Fig. 10.

Notes. Through MEIJER (*l.c.*) attention was drawn to this collection which was pre-identified through the uncanny form knowledge of Mr. NEDI at Bogor. Mr. G. VAN VLIET, Leyden, has examined the leaves anatomically and found no difference with the Bornean species. Dr. VAN STEENIS, who unearthed the Leyden duplicate, has found that it shares a small but significant vegetative character with the Bornean species, viz the occurrence of a shallow, rimmed cavity-like depression at the extreme base of the petiole, similar to that in *e.g.* *Garcinia*; the two small cups together envelop the terminal bud. This is not found in *Memecylon*.

Though in fact he found the sterile macromorphology exactly matching, we like to postpone judgement on specific status until flowers and fruit are available.

About the considerable geographical gap between Borneo and West New Guinea it can be said that true peat forest is not known from this gap at the present time. This is no explanation, however, as the same gap occurs in the genus *Koompassia* (Leg.-Caes.) which is not a peat-forest tree genus; in that genus the New Guinean species is distinct from the two of the Sunda shelf.

3. AXINANDRA

THW. in Hook. J. Bot. 6 (1854) 66, t. 1 C; En. Pl. Zeyl. (1859) 122; B. & H. Gen. Pl. 1 (1867) 784; BEDD. Fl. Sylv. 2 (1869) t. 207; BAILL. Adansonia 12 (1876) 84; CLARKE in Hook. f. Fl. Br. Ind. 2 (1879) 581; COGNIAUX in DC. Mon. Phan. 7 (1891) 1113; KRASSER in E. & P. Nat. Pfl. Fam. 3, 7 (1893) 142, 196; BAKH. f. Rec. Trav. Bot. Néerl. 40 (1943) preprint 332; MEIJER, Ceyl. J. Sc. (Biol. Sc.) 10 (1972) 72; BEUS.-OSINGA & BEUS. Blumea 22 (1975) 262. — *Naxiandra* (BAILL.) KRASSER in E. & P. Nat. Pfl. Fam. 3, 7 (1893) 197, f. 182 A. — Fig. 11.

Leaves elliptic to oblong, sometimes ovate, glabrous; midrib impressed above, prominent beneath; nerves ascending and anastomosing in a looped marginal nerve, intramarginal nerve present. *Inflorescence* terminal or axillary and then at the end of the twigs, erect, poorly branched; axes more or less angular, puberulous; racemes with up to some tens of flowers. Flower-bracts 3 per flower, the outer

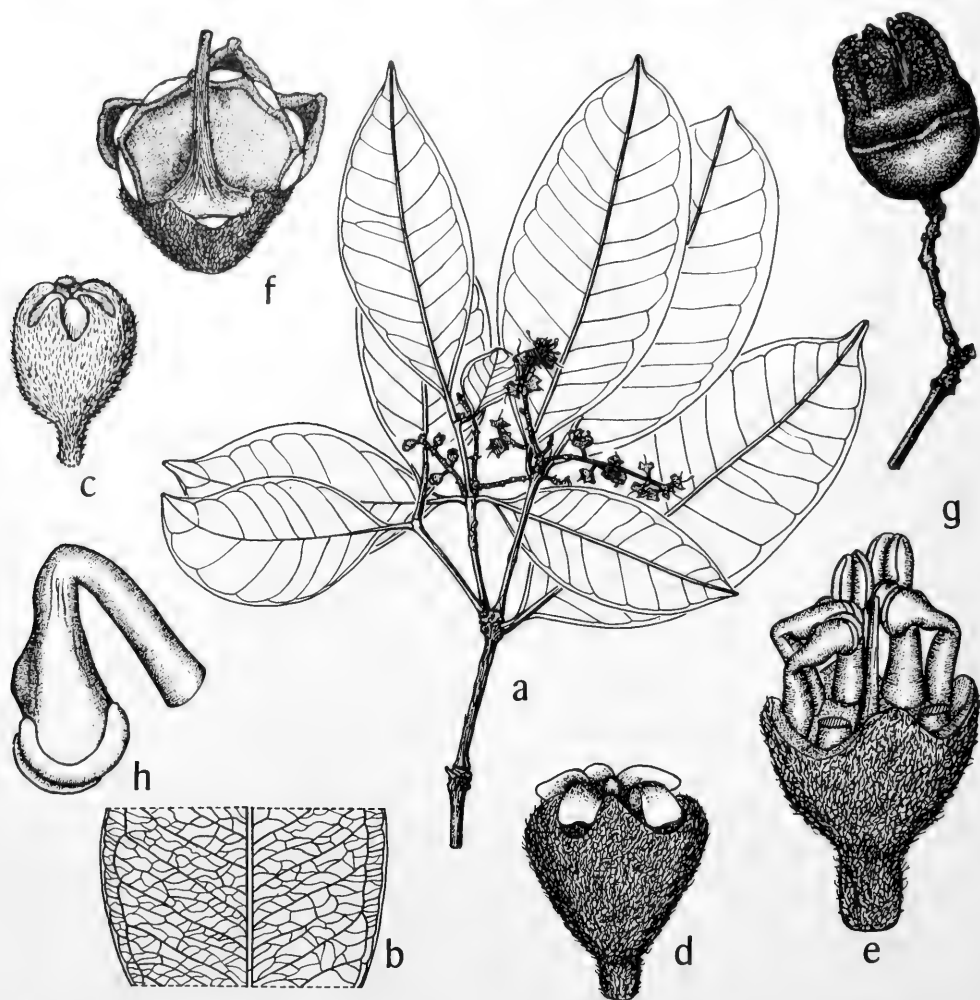


Fig. 11. *Axinandra coriacea* BAILL. a. Habit, $\times \frac{1}{2}$, b. venation undersurface of leaf, nat. size, c. bud, d. older bud, style protruding, petals separating, e. mature flower, petals dropped, f. old flower, petals and stamens dropped, all $\times 7\frac{1}{2}$, g. ripe capsule, $\times \frac{3}{4}$, h. stamen, $\times 15$ (a SAN 57276, c-f, h S 14489, g MEIJER SAN 49845).

ones often minute, persistent during anthesis. *Flowers* bisexual, 5(–4)-merous, pedicelled. *Receptacle* puberulous outside only, glabrescent in fruit, much accrescent and lignified in fruit. *Sepals* 5 (4), deltoid, more or less acuminate, evanescent in fruit. *Petals* 5 (4), valvate-connate or valvate- (or somewhat imbricate)-conduplicate or imbricate-contorted, more or less connate or cohering and soon dropping simultaneously in the shape of an umbrella, flimsy, consisting of a wide basal part tapering into a narrower median part which widens into a whether or not well-developed, frayed apical part, induplicate and enveloping the stamens which are situated in pairs between two longitudinal lamellae on the inside of each petal. *Stamens* 10 (8), epi- and alternisepalous, (sub)equal, caducous; filaments (rather) thick and short, terete, to more or less flattened, tapering upwards; connective

wide, large, conduplicate, mostly provided with a more or less distinct dorsal tubercle; anthers marginally at the apex of the connective, broad-linear, introrse. *Ovary* inferior, immersed in the receptacle, 3-(2-)carpellate, 6-(4-)celled, with free or towards the base somewhat connate septa, glabrous; style (subulate-) terete, shorter to distinctly longer than the receptacle, and whether or not protruding from the ripe bud, glabrous, evanescent in fruit; stigma punctate, minute. *Ovules* 1 or 2 per cell, two (one) by two (one) in vertical position inserted basally on either side of the 3 (2) stouter ones of the 6 (4) septa. *Capsule* half-inferior, big and woody, globose to ellipsoid, (sub)glabrous, when young provided with a fragment of the style, inside dehiscent down to the bottom with 2-6 valves of which only the upper parts protrude from that part of the capsule which is surrounded by and fused with the enlarged receptacle of which the rim often remains visible as an irregular more or less conspicuous rib; visible part of the valves triangular, coarse, solid, deltoid at cross-section, glabrous. *Seeds* few, in vertical position; seed depressed-ellipsoid, situated basally and obliquely in its thin, (narrow-)oblong wing 2-3 times as long as the body of the seed; raphe running from the basal insertion all along the wing margin back to the embryo.

Distr. Ceylon (1 *sp.*) and *Malesia*: Malay Peninsula (one record) and Borneo (3 *spp.*) but nowhere common. Fig. 12.

A. zeylanica was also mentioned to occur in Borneo by BAKHUIZEN *f.* (Rec. Trav. Bot. Néerl. 40, 1943, preprint 332) but HALLIER *f.* 2683, on which this was based, belongs to *A. coriacea*. The same author (*l.c.*) recorded *A. borneensis* BAKH. *f.* (= *A. beccariana*) from Billiton I.; the sheet TEYSMANN *s.n.* was collected, however, on Mt Blitong in Borneo.

As with *Dactylocladus* the extreme rarity of the genus on the Sunda-shelf west of Borneo is remarkable and remains unexplained; so far known *Axinandra* is not bound to a rare or very specialized biotope.

Ecol. Lowland and submontane rain-forest, up to 1200 m.

KEY TO THE SPECIES

1. Connective pear- or drop-shaped. Filaments $1\frac{1}{2}$ -2 mm. Style 2-5 mm. Ovules 2 per cell. *Sect. Naxiandra* BAILL.
2. Internodes winged upwards. Leaf-base rounded to emarginate. Inflorescences distinctly longer than 5 cm. **1. *A. alata***
2. Internodes not winged. Leaf-base shortly attenuate. Inflorescences shorter, or distinctly longer than 5 cm.
3. Leaves chartaceous. Tip of leaf-apex acute. Inflorescence 5-20 cm. Petals *c.* 3 mm. Fruit $1\frac{1}{2}$ -2 by $1-1\frac{1}{2}$ cm; rim of enlarged receptacle about median. **2. *A. beccariana***
3. Leaves coriaceous. Tip of leaf-apex obtuse. Inflorescence stunted, (1-)2-4(-5) cm. Petals *c.* 6 mm (fig. 11d). Fruit 2-3(- $3\frac{1}{2}$) by $1\frac{1}{2}$ -2 $\frac{1}{2}$ cm; rim of enlarged receptacle infra-median (fig. 11g). **3. *A. coriacea***
1. Connective quadrate-elliptic. Filaments *c.* $\frac{1}{2}$ mm. Style shorter than $\frac{1}{2}$ mm. Ovules 1 per cell. *Sect. Axinandra*. Species of Ceylon. ***A. zeylanica* THW.**

1. *Axinandra alata* BAILL. Adansonia 12 (1876) 86; Bull. Soc. Linn. Paris (1877) 128; COGNIAUX in DC. Mon. Phan. 7 (1891) 1114; MERR. En. Born. (1921) 452; BEUS-OSINGA & BEUS. Blumea 22 (1975) 263.

Tree. Twigs glabrous; internodes terete at the base, growing acutely quadrangular upwards with 4 gradually widening wings towards the nodes, (sub)glabrous; wings 1-3 mm (or more?) wide at the top, ending in an acute process often curved upwards, wearing off when older. Leaves 5-10 by 3-5 cm, rounded at the base, cuspidate at the top and with acute tip, chartaceous to subcoriaceous, distinctly reticulate; nerves *c.* 12 pairs, flat above, prominent beneath; petiole 3-5 mm, $1-1\frac{1}{2}$ mm \varnothing . Inflorescence 8-13 cm, consisting of main axis with 1 or 2 pairs of 4-12 cm long primary axes each

bearing 10-35 flowers. Bracts of axes deltoid to triangular, *c.* 1 mm, acute at the top, minutely puberulous, mostly caducous. Floral bracts small, the middle one only slightly exceeding the lateral ones, narrowly triangular, *c.* 1 mm. Pedicels 1-2 mm, *c.* $\frac{1}{2}$ mm \varnothing . Receptacle *c.* 2 mm high, *c.* 3 mm wide, ribbed, densely puberulous. Sepals *c.* $\frac{3}{4}$ mm. Petals *c.* $3\frac{1}{2}$ -4 mm, $1-1\frac{1}{4}$ mm wide at the base, valvate to imbricate at the base, valvate-conduplicate for the rest, more or less connate especially in the median part, almost completely enveloping the stamens. Filaments *c.* 2 mm, $\frac{1}{2}$ - $\frac{3}{4}$ mm wide at the base, glabrous. Connective pear- or drop-shaped, *c.* 1 mm, with dorsal swelling. Anther-cells *c.* 1 mm, *c.* $\frac{1}{4}$ mm wide. Style 3-5 mm, $\frac{1}{4}$ mm \varnothing , protruding from mature bud. Ovules 2 per cell. Fruit not seen.

Distr. *Malesia*: Borneo (Sarawak), only known from the type.

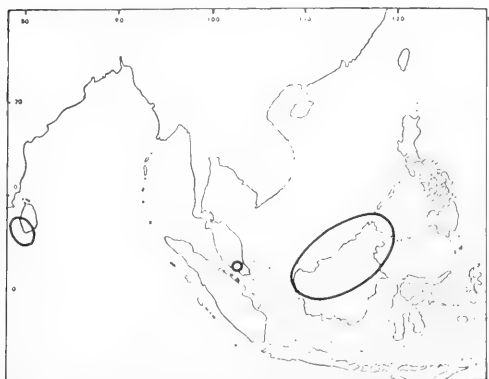


Fig. 12. Range of the genus *Axinandra* THW. In Ceylon 1 *sp.*, in Borneo 3 *spp.* of which one once found in Malaya.

2. *Axinandra beccariana* BAILL. *Adansonia* 12 (1876) 85; *Bull. Soc. Linn. Paris* (1877) 127; *COGNIAUX* in *DC. Mon. Phan.* 7 (1891) 1114; *MERR. En. Born.* (1921) 452; *BEUS.-OSINGA & BEUS. Blumea* 22 (1975) 263. — *A. maingayi* CLARKE, *Fl. Br. Ind.* 2 (1879) 581; *COGNIAUX* in *DC. Mon. Phan.* 7 (1891) 115; *RIDL. Fl. Mal. Pen.* 1 (1922) 826. — *A. borneensis* BAKH. *f. Rec. Trav. Bot. Néerl.* 40 (1943) preprint 332.

Tree. Twigs glabrous or very minutely puberulous. *Leaves* 5–10 by 2–5 cm, shortly attenuate at the base, acuminate to cuspidate at the top, with acute tip, chartaceous, faintly reticulate; nerves 8–12 pairs, flat above, prominent beneath; petiole 5–8 mm, 1–2 mm Ø. *Inflorescence* 5–20 cm, branched up to the second order, with slender axes each bearing up to *c.* 15 flowers; primary axes up to 4 pairs, 4–15 cm. Bracts of the axes deltoid to narrowly triangular, 1–3 mm, acute at the top, subglabrous, mostly caducous, sometimes partly present as small or reduced leaves. Floral bracts small, the middle one triangular to linear-lanceolate, $\frac{1}{2}$ –4 mm, the lateral ones minute. Pedicels 1–2½ mm, *c.* ½ mm Ø. *Receptacle* *c.* 2 mm high, *c.* 3 mm wide, sometimes faintly ribbed, sparsely minutely puberulous. *Sepals* *c.* ½ mm. *Petals* *c.* 3 mm, *c.* 1 mm wide at the base, valvate, almost completely connate, only enveloping the dorsal and part of the apical side of the stamens. *Filaments* *c.* 1½ mm, *c.* ½ mm wide at the base, glabrous. Connective pear- or drop-shaped, *c.* 1½ mm, with dorsal swelling. Anther-cells *c.* 1 by *c.* ¼ mm. *Style* *c.* 2 mm, *c.* ½ mm Ø, hardly or not protruding from mature bud. *Ovules* 2 per cell. *Capsule* 1½–2 by 1–1¼ cm, faintly 10-ribbed, rim of enlarged receptacle about median; valves *c.* ¾ cm. Seeds not seen.

Distr. *Malesia*: Borneo and Malay Peninsula (Malacca, one old record). Fig. 13.

Ecol. Lowland forests.

Note. From the Malay Peninsula only one collection is known (MAINGAY 654–2, type of

A. maingayi). The differences between this specimen and the material from Borneo as mentioned by CLARKE *l.c.* are in my opinion of minor importance; consequently, I have included *A. maingayi* in the synonymy of *A. beccariana*.

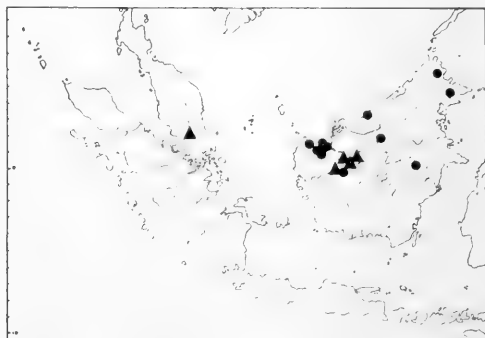


Fig. 13. Localities of *Axinandra beccariana* BAILL. (triangles) and *A. coriacea* BAILL. (dots).

3. *Axinandra coriacea* BAILL. *Adansonia* 12 (1876) 85; *Bull. Soc. Linn. Paris* (1877) 127; *Hist. Pl.* 7 (1880) 28, f. 43; *COGNIAUX* in *DC. Mon. Phan.* 7 (1891) 1114; *MERR. En. Born.* (1921) 452; *BEUS.-OSINGA & BEUS. Blumea* 22 (1975) 264. — *Naxiandra coriacea* (BAILL.) KRASSER in *E. & P. Nat. Pfl. Fam.* 3, 7 (1893) 197. — Fig. 11.

Tree up to 35 m, 50 cm Ø. Twigs glabrous. *Leaves* 5–10(–12) by $(1\frac{1}{2})$ –2–5(–6) cm, shortly attenuate, sometimes acute at the base, acuminate to cuspidate at the top, with obtuse tip, coriaceous, conspicuously reticulate; nerves 8–12 pairs, flat above, prominent beneath; petiole 5–8 mm, *c.* 1–2 mm Ø. *Inflorescence* (1)–2–4(–5) cm, consisting of a few, sometimes one 1–5 cm long rather coarse, sometimes stunted axes, each bearing 0–15 flowers. Bracts of the axes deltoid to triangular, *c.* 1 mm, obtuse at the top, subglabrous, mostly caducous. Floral bracts small, the middle one deltoid to triangular, *c.* 1 mm, the lateral ones minute. Pedicels 1–2½ mm, *c.* 1 mm Ø. *Receptacle* *c.* 3 mm high, 3–4(–5) mm wide, densely puberulous. *Sepals* *c.* 1 mm. *Petals* *c.* 6 mm, *c.* 1½ mm wide at the base, valvate at the base, conduplicate-valvate for the rest, more or less connate in the median part, mostly almost completely enveloping the stamens. *Filaments* 1½–2 mm long, ¾–1 mm wide at the base, glabrous. Connective pear- or drop-shaped, *c.* 1½ mm, with dorsal swelling. Anther-cells *c.* 1½ mm, *c.* ¼ mm wide. *Style* 2–5 mm, *c.* ½ mm Ø, protruding from mature bud. *Ovules* 2 per locule. *Capsule* 2–3½ by $1\frac{1}{2}$ –2½ cm; rim of enlarged receptacle infra-median; valves ½–1(–1½) cm. *Seeds* 0.7–0.8(–1) by 0.3–0.4(–0.5) cm; wing *c.* ½ cm wide.

Distr. *Malesia*: Borneo. Fairly rare. Fig. 13.

Ecol. Primary (dipterocarp) forest at low and medium altitude, up to 1200 m, also recorded from ultrabasic red-brown soil.

Field notes. Buttresses when present up to 1½–2 m vertically. Bark surface flaky. Stamens pale yellow. Flowers greenish; corolla white.

Vern. *Ubah*, Iban, Sarawak, *obah*, Sabah.

SYMPLOCACEAE (H. P. Nooteboom, Leyden)¹

The family consists of one genus only, *Symplocos*, which occurred already in the Eocene over the entire northern hemisphere in the mixed mesophytic forest and in all probability also in the Indo-Australian tropics.

As proved by abundant fossil endocarps, the Eocene species had already a fruit structure very similar to that of now living species and the genus existed at that early time obviously already in *optima forma*, a reason to assume that it must be of high antiquity. This is also corroborated by the fact that the tropical subgenus *Symplocos* has a very disjunct trans-Pacific range; explanation by chance transoceanic long-distance dispersal must be refuted because it is in contradiction with all presently known facts.

Although *Symplocos* has shown a fairly abundant speciation, considering its present size and 25 fossil species described, it has surprisingly not led to other generic development and remained in splendid isolation.

Its systematic affinities induced mostly to classify it with *Ebenales*. In my monograph of the Old World species (1975) I have brought all evidence together and have concluded that this position is unlikely: pollen structure differs from that in other families of *Ebenales*, so do the stomata, the placentation and the structure of the ovules. This leads to the view that *Symplocos* is more allied to *Cornaceae* and *Theaceae*, sharing also with both families a primitive wood anatomy. Still the affinity is not that close, as for example *Theaceae* have a truly axile placentation. The chromosome number fits better with *Cornaceae sens. lat.*

SYMPLOCOS

JACQ. En. Fl. Carib. (1760) 5, 24; Select. Stirp. Am. Hist. (1763) 166, t. 175, f. 68; LINNÉ, Gen. Pl. ed. 6 (1764) 272; MIERS, J. Linn. Soc. Bot. 17 (1879) 285; BRAND, Pfl. R. Heft 6 (1901) 13, 9 fig.; NOOT. Leid. Bot. Ser. 1 (1975) 33, 7 fig., 21 pl., with full synonymy. — **Fig. 1–20.**

For synonyms see under the subgenera.

Shrubs to (rarely) large, (in Mal.) evergreen trees; bark in various *spp.* bitter; growth continuous or interrupted (in flushes), in the latter case the buds protected by often leathery bud-scales; glabrous or hairy (by simple hairs). *Leaves* simple, alternate or spirally arranged, rarely pseudovercillate, estipulate, penninerved, petioled, rarely almost sessile; when dry often discolouring (often in yellow tinges) in *subg. Hopea*. *Flowers* in spikes, racemes, or panicles, mostly from the upper leaf-axils, sometimes condensed to clusters, sometimes terminal or from the axils of fallen leaves, rarely solitary; supported by a bract and 2 bracteoles, rarely several bracts and bracteoles by abortion of flowers; flowers actinomorphic, bisexual, rarely by reduction unisexual and plant polygamous, not rarely fragrant, distinctly so in *subg. Symplocos*. *Calyx* with a very short tube above the inferior ovary, the limb 3–5-lobed, imbricate, persistent, sometimes split into two parts and seemingly 2-lobed. *Corolla* sympetalous, but divided nearly to the base in *subg. Hopea*; lobes (3–)5(–10 in the New World), quincuncially imbricate, whitish, bluish or purplish. *Stamens* 4 to mostly ∞ , connate in a long monadel-

(1) With co-operation of the General Editor.

phous tube, at its base adnate to the corolla and very unequal, but in *subg. Hopea* only connate at the very base, monadelphous or pentadelphous and then the bundles alternipetalous; anthers globose, 2-celled, lengthwise dehiscent, introrse. *Ovary* inferior (to \pm semi-inferior), 2–5-celled, with a complete septation; style 1, stigma punctiform or peltate. *Ovules* 2–4 in each cell, pendulous, anatropous-epitropous or amphitropous, unitegmic, tenuicellular. *Drupe* monopyrenous, crowned by the persistent calyx lobes, of various shape: cylindrical to globose, ampulliform or spindle-shaped; mesocarp usually thin, sometimes thick and then often quite hard; stone smooth or mostly sculptured in various degree or lengthwise ridged. *Seeds* straight or curved, 1 in each developed cell, with copious endosperm; embryo straight or curved, with very short linear cotyledons.

Distribution. About 250 *spp.*, in the eastern parts of the Old World, from Ceylon and Bombay in the Deccan to Fiji in West Polynesia and from Manchuria at 46° N as far as New South Wales and Lord Howe I. at 32° S; in the New World from the State of Washington in the U.S.A. to S. Brasil; throughout *Malesia*. Fig. 1.

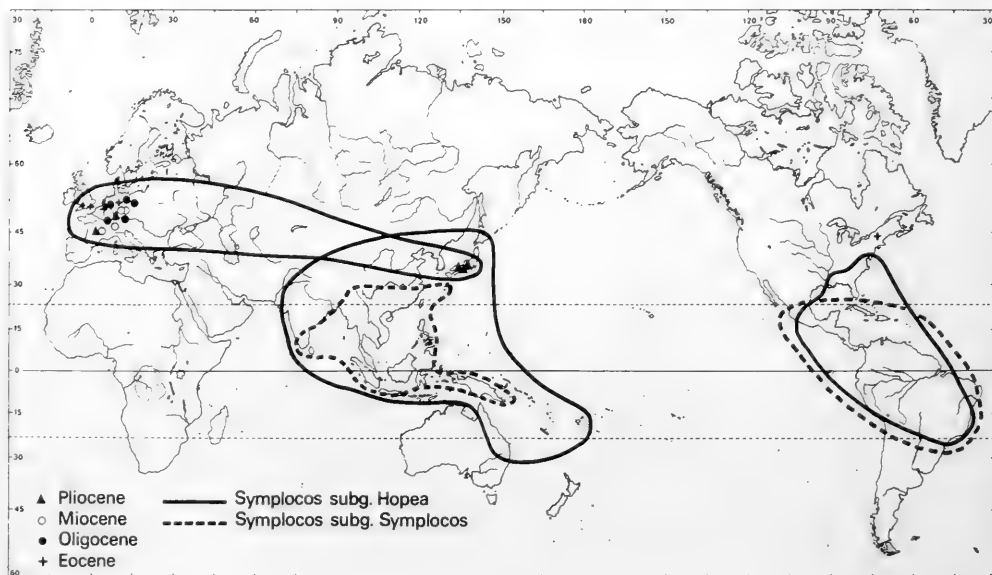


Fig. 1. Range of the genus *Symplocos*, recent and fossil. The fossil localities in Europe, Japan, and E. North America are all belonging to species of *subg. Hopea*.

There is no species common to the Old and New World, but the E. Asian *S. lucida* is closest allied to the N. American *S. tinctoria*.

Taxonomy. BRAND (1901) has made an intricate subdivision of the genus, partly based on former generic names. I believe we cannot go further than a subdivision into two subgenera, in which macromorphology is supported by chemotaxonomy and palynology, viz *subg. Symplocos* and *subg. Hopea*.

Subdivisions could be based on one important single character: straight *versus* curved embryo, spiral *versus* distichous phyllotaxis, continuous *versus* flushwise growth from scaly buds, but it appears that such subdivisions do not coincide. This leads to the view that there is a block of species with reticulate affinities. This view also emerges from the palynological results.

Both subgenera occur in the New and the Old World; *subg. Symplocos*, which is almost strictly tropical, possesses only 2 *spp.* in Indo-Malesia, but probably many more in America.

In this revision 58 *spp.* are distinguished in Malesia; there are more new species, but I have refrained from describing them as the material is incomplete; I have enumerated them in my revision *l.c.* 296.

Fossils. Before the Glacial Epoch *Symplocos* occurred also in Europe in the mixed mesophytic subtropical to warm-temperate forest, onwards of the Eocene, obviously as a common constituent of the Tertiary mixed mesophytic forest, as shown from fossil stones. *Cf.* KIRCHHEIMER, *Palaeontographica* 90B (1949) 1-52, t. 1-2. These stones are very similar to endocarps of recent species; obviously no major changes did occur in the genus during this era. The three fossil Pliocene species in Japan are almost certainly the same as those that are living there today. One fossil species is known from the Eocene in the eastern U.S.A. Fig. 1.

Ecology. All species are evergreen, except a single deciduous one, *S. paniculata* (THUNB.) MIQ. from Kashmir to Manchuria and Japan.

They grow under tropical to temperate conditions in mixed evergreen rain-forest, not under arid conditions.

Their stature is mostly small and they make part of the undergrowth and lower storeys, in exceptional cases attaining a maximum height of c. 30 m and 60 cm \varnothing .

In Malesia they are found from sea-level up to the alpine zone at c. 4000 m (Mt Kinabalu; New Guinea), where they are represented by mostly microphyllous (fig. 12) dwarf shrubs in the dense elfin and mossy forest on slopes, summits and ridges where they may be common; but they are almost nowhere recorded as a dominant.

A few species, *e.g.* *S. polyandra*, are restricted to the lowland, but most species have a fair altitudinal range, and are most commonly collected in the hill and mountain forest. A few are restricted to high altitude, *e.g.* *S. buxifolia*, *S. deflexa*, *S. johniana*, *S. zizyphoides*, and several varieties of *S. cochinchinensis*.

A fair number seem to be rare and have been seldom collected, others are common and widely distributed in the archipelago, notably *S. cochinchinensis*, *S. celastriifolia*, *S. fasciculata*, *S. laeteviridis*, *S. ophirensis*, and *S. odoratissima*.

Especially these species, several of which are variable, grow on a variety of soils, including young-volcanic; they are scarce on limestone and generally prefer more acid, humous soils, *e.g.* *S. celastriifolia* is common in coastal forests, especially in the transition between mangroves and freshwater swamps, but it occurs also on kerangas, along river banks, and even in peat swamp forest.

S. cochinchinensis var. *sessifolia* is very resistant against poisonous crater gases and acid soil conditions and can act as a pioneer in crater fields in Java, sometimes dwarfing down to very small size, although still producing flower and fruit; in the surrounding closed elfin forest it is a common small tree, growing together with *Vaccinium*, *Myrica*, *Myrsine*, *Leptospermum*, etc.

Density of species. In fig. 2 the density of species has been indicated for each province and island (group). The richest areas are those of continental SE. Asia and West Malesia, while the number of species tapers out towards East Malesia and the SW. Pacific. The greatest number of endemic species is found in West Malesia, notably (as usually) in Borneo and the Philippines. However, in East Malesia New Guinea has a fair number of endemic species. The high number of endemics in New Caledonia is a bit exaggerating the situation as all are certainly derivatives of *S. cochinchinensis*. The same holds for the endemics of New Guinea (with the exception of *S. cylindracea*) and for Australia (with the exception of *S. cyanocarpa* C. T. WHITE).

Flower biology. In all *Symplocos* *spp.* the flowers of an inflorescence open almost simultaneously and on one tree almost all inflorescences are open at the same time, so that the whole crown is for a short time gay with the blossoms (fig. 3). Of *S. cochinchinensis* var. *sessifolia* flowers are deliciously scented, as hawthorn, but field records mention other species as scentless or faintly scented. This varies obviously with the species.

Pollination. DOCTERS VAN LEEUWEN (Verh. Kon. Ak. Wet. A'dam sect. 2, 31, 1933, 218) reported of *S. cochinchinensis* var. *sessifolia*, on the summit of Mt Pangrango, West Java, at c. 3000 m, that flowers expand in the morning but open only halfway, the corolla remaining bent over the sexual organs; at 8 h. anthers are open and often touch the stigma on which the sticky

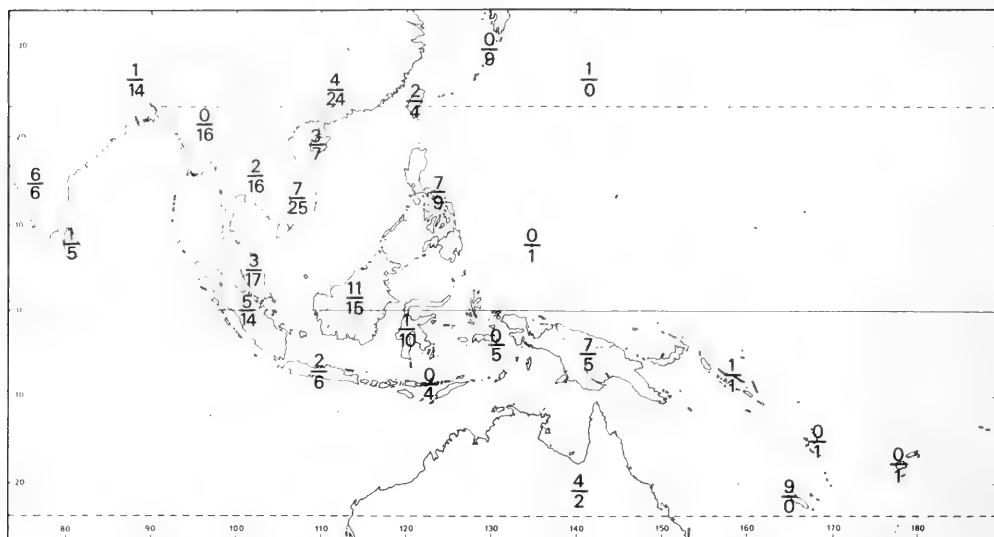


Fig. 2. Density of species in Old World *Symplocos*; above the hyphen the endemic species for each island (group) or country, below the hyphen the non-endemic species.



Fig. 3. *Symplocos laeteviridis* STAPF var. *laeteviridis* in full flower, showing also alternate phyllotaxis.—Sabah (NOOTEBOOM 1017). Photogr. NOOTEBOOM, Febr. 1969.

pollen readily falls; on the 2nd flowering day the corolla is widely open, anthers are empty, and the stigma is always pollinated. This means self-pollination. DOCTERS VAN LEEUWEN found, however, also the flowers frequented by various insects, among them bees and bumble-bees. They are not so much attracted by the little nectar, but are in search of pollen.

Some species may have locally a strict flowering time; e.g. *S. cochinchinensis* var. *sessifolia* flowers, according to DOCTERS VAN LEEUWEN (*l.c.*, fig. 52), from October to January, in the rainy season, on the summit of Mt Pangrango, West Java.

Hybridization. Though there are in a few instances indications (by high sterile pollen %) that hybridization may occur, no clear cases are recorded. It is, however, clear that cross-fertilization must occur in the polygamous species in East Malesia.

Galls. DOCTERS VAN LEEUWEN (Zooecidia, 1926, 460) found in *S. cochinchinensis* var. *sessifolia* small leaf galls, caused by psyllids by which the two halves of the leaf curve upwards till margins touch and a narrow cavity is formed. He recorded similar galls also from other forms of this species. In *S. fasciculata* he found a stem gall caused by a gall-midge and in *S. brandisii* a flower gall caused by a gall-midge.

Dispersal. RIDLEY (Disp. 1930) assumed that bats may be fond of the hard-fleshed drupes (*l.c.* 347). He mentioned that in North America tyrant birds (*Sayornis phoebe*) eat amongst others fruit of *S. tinctoria* (*l.c.* 483) and that in South America a curassow, a sort of turkey, would feed on the fruit of *S. cernua*. DOCTERS VAN LEEUWEN (Verh. Kon. Ak. Wet. A'dam sect. 2, 31, 1933, 220) believed *Symplocos* to be dispersed by birds but did not find endocarps in the stomach of fruit-eating birds. VAN STEENIS found fruit of *S. henschelii* abundant on the ground below trees at Tjibodas, although this species has a fairly thick, hard-fleshed exocarp, in contrast to most species in which the exocarp is thin. Also in fossils sometimes immense quantities of stones are found together, about which KIRCHHEIMER reported (Palaeontographica 90B, 1949, 1-52): in a total mass of c. 3500 m³ he estimated the number of endocarps at some 2¹/₂ billions. He assumed that these were deposited within one century in a site of forest dominated by *Symplocos*. However, he added that the layers in which the endocarps were deposited gave no evidence of rivers which could have transported and accumulated the seeds and he concluded that they have dropped to the soil in situ. For these reasons abundant dispersal by birds or bats is in *Symplocos* not very likely.

Dispersal by water takes place in species in which some fruit cells are barren and remain empty, e.g. *S. celastrifolia*.

Morphology. The phyllotaxis is variable but constant for the species; it is either spiral or alternate (distichous) in which latter case the twigs are often zigzag (fig. 3).

In most species leaves are more or less equally dispersed along the twigs, but in other species there is a tendency that the leaves are becoming crowded towards the end of the year's growth, e.g. in *S. macrocarpa*, as noted by TRIMEN (Handb. Fl. Ceyl. 3, 1895, 103). In Malesian spp. this occurs also in *S. herzogii* and *S. gigantifolia* where the large leaves occur crowded at the end of the year's growth.

There is a single species in which all the leaves are in real pseudo-whorls, viz *S. verticillifolia* from the Philippine Is. (fig. 20).

The leader-shoots in *Symplocos*, e.g. *S. fasciculata*, have spiral phyllotaxis; such shoots may, however, also carry flowers.

Rejuvenation is in certain species by continuous growth of the twig apex, as is e.g. characteristic in *S. fasciculata*. In other species, however, there are clear buds with conspicuous bud-scales, indicating that the growth mode is flushwise and discontinuous, as e.g. in *S. costata* and *S. lucida* (fig. 15). This might be a good character of subdividing subg. *Hopea*. It can, however, only be used if one has accurate knowledge of the rejuvenation process of each species. This is sometimes difficult to ascertain from herbarium material as the bud-scales do not always leave traces of distinct scars, field data hardly ever mention the character, and material is seldom collected in the stage of flush. If the growth mode were well examined in all species I believe it would represent a good key character.

Flushwise, discontinuous growth, with scaly buds could be assumed to be an adaptation to seasonally cold climates. It is a life form intermediate halfway evergreen and deciduous. It is rare in the Malesian tropics where it is known e.g. from *Acer*, some genera of *Lauraceae*, *Fagaceae*,

which also in the tropics are found in the cool, tropical-montane climate, which is however hardly seasonal. It still could be viewed as an indication of former immigration of taxa of higher latitude. Once acquired this growth mode must then have been conserved, as it occurs also in *S. barringtoniifolia* which is restricted to the tropical lowland.

The inflorescence is either a panicle or a raceme or spike. Morphologically it is cymose, the flower always being sustained by two bracteoles which may at times carry abortive buds in their axil (fig. 11b). In some cases the inflorescence is condensed to a fascicle or cluster of flowers (fig. 20a) or even be reduced to a single flower (fig. 19a). In a few species flowers occur on old wood, as e.g. in *S. polyandra*, *S. wikstroemifolia* (p.p.), *S. rubiginosa*, and *S. tricoccata*.

The flowers are bisexual but functionally unisexual flowers are found in several taxa, especially in New Guinea. Such taxa are either dioecious or polygamous. In male flowers the style is small and without a stigma, in female flowers the number of stamens is reduced (even to less than 10) and anthers are sterile. In *subg. Symplocos* the stamens are monadelphous with a long tube (fig. 6a, d); in *subg. Hopea* they are only connate at the base for at most 2 mm (fig. 11c), and intergrading from strictly monadelphous to strictly pentadelphous, the phalanges being alternipetalous.

In my revision it has been explained that, in contrast with former opinion, the ovary is initially 1-celled, with the ovules attached close to the centre on the induplicate part of the carpels, each of the 2-5 compartments having usually 4 ovules; in fruit these appear as cells. In each developed cell there is usually one seed. The latter and the embryo it contains may be curved or straight. See fig. 4b, c, g, h, j, k.

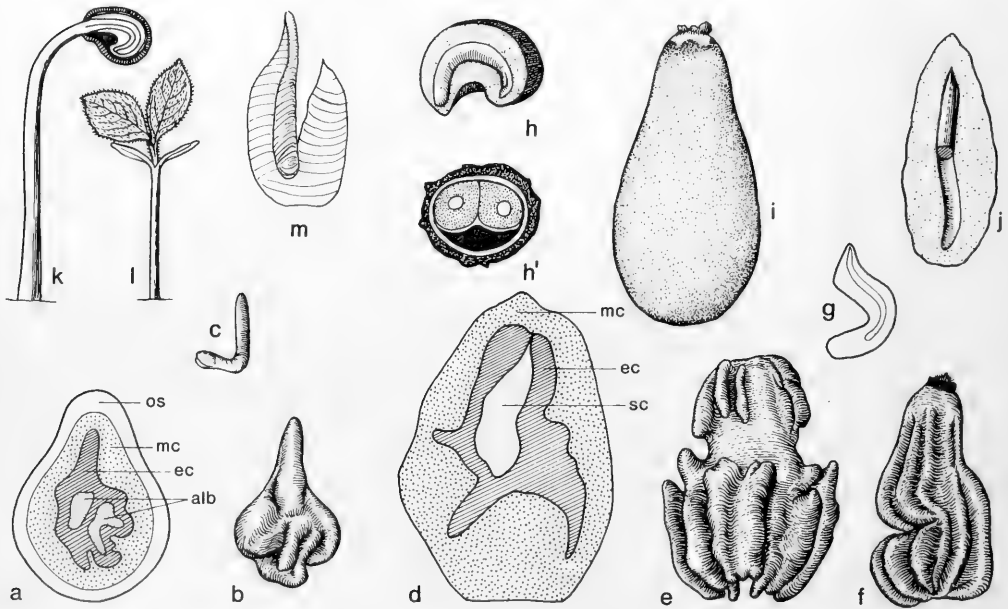


Fig. 4. *Symplocos ophirensis* CLARKE ssp. *perakensis* (K. & G.) NOOT. var. *perakensis*. a. LS of fruit, out of centre, b. seed, c. curved embryo, with 2 short apical cotyledons, all $\times 4$. — *S. ophirensis* CLARKE ssp. *cumingiana* (BRAND) NOOT. var. *cumingiana*. d. LS of fruit, seed cavity empty, e. stone, $\times 4$. — *S. macrophylla* WALL. ex DC. ssp. *cordifolia* (THW.) NOOT. var. *apicalis* (THW.) NOOT. f. Ribbed stone, with fold, g. seed, the curved embryo enveloped by the albumen, $\times 2$. — *S. paniculata* (THUNB.) MIQ. h. LS of seed showing curved embryo, h'. ditto in CS, showing how such seed may appear deceptively as 2 seeds, $\times 1\frac{1}{2}$. — *S. glauca* (THUNB.) KOIDZ. i. Fruit, j. seed in LS showing straight embryo, $\times 3$. — *S. paniculata* (THUNB.) MIQ. k. Germinating seedling with LS of endocarp and seed, showing mode of exit of embryo, $\times 1\frac{1}{3}$, l. seedling, $\times \frac{2}{3}$. — *S. celastriifolia* GRIFF. ex CLARKE. m. U-shaped seed, $\times 6$ (a-c BURKILL 1013, d-e NOOTEBOOM 2229, f-g ASHTON 2480, k-l after LUBBOCK). — alb albumen, ec stony endocarp, mc mesocarp, os outer surface of fruit, sc seed cavity.

The fruit is a drupe, with a fleshy, corky or woody mesocarp and a very hard stone (endocarp). The endocarp may be smooth (fig. 10c, 19d) or show outside ridges or irregularities (fig. 4e, f, 9c, 10e, 14d); the same holds for the inside of the endocarp. In the centre of the copious endosperm the embryo is embedded. It is slender and may be straight or curved. In the tropical *subg. Symplocos* it is always straight. In *subg. Hopea* it is straight in all American *spp.* and in 80% of the living species in the Old World and also in all fossil species in Europe. From this it is concluded that a straight embryo seems to be the primitive state in the genus. Only the three Pliocene fossil species of Japan, which can be matched with living species, have curved seeds and consequently curved embryos.

Curved seeds occur in degree, they may be hook-shaped or U-shaped or even be twice curved (S-shaped in *S. brachybotrys*). See fig. 4. This may give some difficulty in studying sections of the stones to count the number of seeds in a fruit (e.g. fig. 4h-h').

Although of the living species only 20% have curved seeds the vast majority of the individual living plants have curved seeds; so it seems that this probably recent trend in the evolution of the genus was successful although the reason for its origin and advantage of its function remains obscure.

Seedlings. Few observations are made. LUBBOCK (Contr. Knowl. Seedlings, 1892, 206–208, fig. 509) noted for *S. paniculata* (sect. *Hopea*): the endocarp does not burst during germination; the radicle emerges by a small hole at the apical narrow end; the hypocotyle elongates, becoming curved, finally straightening, carrying up the endocarp containing the embryo. As the cotyledons elongate, they push out at the small hole in the endocarp (so to say throw the latter off), and finally get free and spread out to the light; they enlarge but remain narrow. The first two leaves are opposite, hairy on both sides and serrulate which may persist in leaves of saplings (fig. 4l).

Spot-characters. In the herbarium a *Symplocos* of *subg. Hopea* can mostly easily be spotted by spiral, exstipulate, eglandular, serrate or crenate leaves discolouring pale greenish or yellowish or greenish-brown, a feature connected with a high Al-content of the tissues. At a very young stage, the just expanding leaves have proportionally conspicuous gland-like teeth on the margin. A significant character is that in the herbarium the midrib is always sulcate above, with the exception of 4 *spp.* in which it is prominent: *S. anomala*, *S. lancifolia*, *S. lucida*, and *S. wikstroemifolia*.

The cup-like 3 bracts (of which 2 bracteoles) below the flower (fig. 11b) is also characteristic as is the inferior ovary and fruit.

Innovations and newly expanded leaves are in many species a beautiful violet, afterwards changing into violet-brown while the drupes are often blue to black-violet, features found in many aluminium-accumulating plants (*Eurya*, *Helicia*, etc.).

Anatomy. For general surveys also covering the older literature, see SOLEREDER, Syst. Anat. Dicot. Stuttgart (1899) 587–589 (under *Styracaceae*) and *ibid.* (1908) 208–210; METCALFE & CHALK, Anat. Dicot. Oxford (1950) 890–893. Selected references: JANSSONIUS, Mikr. 4 (1925) 471–498 (wood anatomy); DEN BERGER, Determinatietabel Malesië, Veenman, Wageningen (1949) (wood identification); JANSSONIUS, Blumea 6 (1950) 422–423 & 424 (wood anatomical affinities); DESCH, Mal. For. Rec. 15 (1954) 591–593 (wood); ZAHUR, Mem. Cornell Univ. Agric. Exp. Stn. 358 (1959) 35 (bark anatomy); HUBER, Mitt. Bot. Staatssamml. München 5 (1963) 1–48; BAAS, Blumea 21 (1973) 201–216 (ecological wood anatomy); NOOTEBOOM, Leid. Bot. Ser. 1 (1975) 20–22 (leaf and wood anatomy).

The wood is characterized by the following primitive set of characters: Vessels solitary and with many-barred scalariform perforations. Fibre-tracheids with conspicuously bordered pits on both radial and tangential walls. Parenchyma diffuse or diffuse-in-aggregates. Rays heterogeneous, usually of two distinct sizes. The bark is also of a primitive type with compound sieve plates. Mechanical bark tissue is poorly developed and composed of groups of sclereids (ZAHUR, *l.c.*). The leaf anatomy exhibits few constant characters such as paracytic stomata, clustered crystals and dorsiventral mesophyll. Presence or absence of a hypodermis, of idioblastic leaf sclereids, of a complex vasculature pattern in the midrib, and of an indumentum varies. The diagnostic and systematic value of these characters remains to be assessed.

The anatomical evidence is inconclusive with respect to a positive indication of the closest affinities of *Symplocaceae*. The traditional treatment of the family as a member of the *Ebenales*

close to *Styracaceae* must, however, be refuted. The anatomy is more compatible with suggestions of a Cornalean or a Thealean alliance as advocated by NOOTEBOOM *l.c.*

Palynology. The palynology of the Old World *spp.* was examined by R. VAN DER MEIJDEN (Pollen et Spores 12, 1970, 513–551, 1971, suppl. in my Monograph, 1975, 9–15). The essential results are the following: the two main pollen types coincide with the distinction of the two subgenera. In *subg. Symplocos* there are two minor types, one belonging to the Old World *spp.*, the other to those of America.

In *subg. Hopea* there are 9 subtypes, but none is apparently peculiar to American *spp.* The distribution of these subtypes is rather complicated and leads to the view of reticulate relationship, which agrees with the impression gained from macromorphology. Another feature is that within the variable species several subtypes are represented, and furthermore that a number of subtypes are found in species which are taxonomically not closely related. There is no agreement between the shape of the embryo, straight or curved, and pollen subtypes. Echinate pollen is found in the Philippine *S. whitfordii* and in the East Malesian and Pacific varieties of *S. cochinchinensis ssp. leptophylla*; also the 9 endemic *spp.* of *Symplocos* in New Caledonia which are all related to this subspecies have echinate pollen.

In several taxa a certain amount of pollen is sterile and I have ascribed this to hybridization.

Phytochemistry. Many species of *Symplocos*, especially from *subg. Hopea*, contain aluminium compounds, a feature which manifestates itself in the yellow colour of dried leaves. Especially when the plants are dried after having been conserved in alcohol vapour according to the Schweinfurth method, the yellow colour becomes very intense. The yellow colour is the result of a reaction of aluminium compounds with flavonols in the drying leaf. The amounts recorded in literature vary between 0.05 and 4.2% of dry weight of the leaves; barks may contain similar amounts of aluminium (CHENERY, Kew Bull. 1948, 173–183; Analyst, 1948, 501; NOOTEBOOM, Leid. Bot. Ser. 1, 1975, 19). RADLKOFER (Ber. Deut. Bot. Ges. 22, 1904, 216–224) already mentioned that the ash of *Symplocos* leaves contains *c.* 50% aluminium oxide. He also described the so-called “Tonerdekörper” in the leaves of *Symplocos*. These are masses of colourless material filling often large parts of the cells, predominantly in the palissade parenchyma. According to RADLKOFER these masses consist mainly of aluminium compounds. KRATZMANN (Sitz. Ber. Ak. Wiss. Wien, 1913, 311–336) found that these aluminium bodies also contain much other material, for instance silicates, and that the aluminium is also accumulated in other parts of the leaf. NEGER (Flora N.F. 16, 1923, 326–330) observed that the development of plants of *Symplocos lucida* (THUNB.) S. & Z. depends on the amount of aluminium compound in the solution they are cultivated on. Plants grew best on a solution containing 1 promille aluminium. Besides aluminium many other compounds are found (HEGNAUER, Chemotaxonomy der Pflanzen 6, 1973). The more important are: 1) Phenolic compounds (see also BATE SMITH, J. Linn. Soc. Bot. 58, 1952, 95–173). Gallic and ellagic acid seem to be rather common. Leucoanthocyanins occur in varying amount. BATE SMITH *l.c.* also found quercetin, and caffeic acid. In the bark of *S. lucida* (THUNB.) S. & Z. the lignan glycoside symplocosin has been found, and traces of methylsalicylate were demonstrated in the bark of several species. True tannins were not yet found in *Symplocos*. 2) Alkaloids. Only for two species structurally known alkaloids were described. More research is needed. 3) Saponins. In several species saponin-like compounds were found, as well in the bark as in the leaves. — R. HEGNAUER.

Chromosomes. In my monograph I have given an account of chromosome numbers, which are unfortunately too few. However, the majority is $n = 11$, with some deviations; rarely $2n = 24$, and one count of the North American *S. tinctoria* of $1n = 14$, all in *subg. Hopea*. The one count known of *subg. Symplocos* in Malesia yielded $2n = c. 90$ ($2n = 88$ would fit an octoploid). It would be too rash to conclude that polyploidy would be normal in that subgenus.

On the other hand it may tentatively be concluded that species in *subg. Hopea* are diploid, with $x = 11$. This does not fit the numbers found in other *Ebenales* families, nor in *Theaceae*, but it does agree with *Cornaceae sens. lat.*

Uses. As timber *Symplocos* has no great value, according to HEYNE (Nutt. Pl. 1927, 1262). Leaves and bark of *Symplocos* contain a fair amount of alum, both in Asian and American *spp.* (cf. Ber. Deut. Bot. Ges. 22, 1904, 126). This was commonly used, mostly from decoctions of the bark, in dyeing processes (red and brown), *e.g.* in the batik industry in Java. RUMPHIUS already

mentioned this use from the Moluccas. Several species were used for this purpose, e.g. *S. cochinchinensis*, *S. fasciculata*, *S. odoratissima* (HEYNE, l.c.). The same compound is probably also the constituent active in medicinal uses against so-called sprue ('thrush') as 'obat seriawan'.

Notes. Identification of material of *Symplocos* is for several reasons far from easy. Because of simultaneous flowering flowers and fruits are practically never found together and both stages are properly needed. Only few species possess well definable vegetative characters. Moreover, a few widespread species have proved to be rather variable, to a fair degree by racial differentiation. These are the reasons that besides a general key in which all characters are used, I have found it useful to add a number of partial keys for islands or island groups in a double series, either for fruiting or for flowering material.

In fig. 5 a scheme is given elucidating the way in which for this genus descriptive terminology is used in the keys and descriptions.

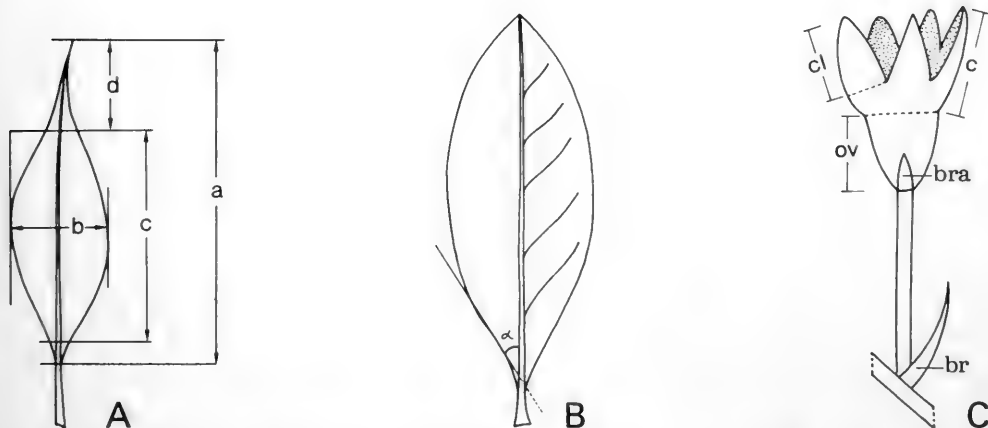


Fig. 5. Schemes elucidating descriptive terminology used in the text. — A: *a* length of leaf, *b* width of leaf, *c* divided by *b* is leaf index, *d* length of acumen. — B: way of expressing base angle α . — C: deflorated flower; *br* bract, *bra* bracteole, *c* length of calyx, *cl* length of calyx lobes, *ov* height of ovary.

KEY TO THE SUBGENERA

1. Petals connate at least halfway up. Leaves usually not becoming yellow when drying, not discolouring, spirally arranged, entire. Flowers very fragrant. Seeds and embryo straight. *Spp.* 1–2
1. Petals connate only at the very base. Leaves usually becoming more or less yellow or greenish yellow when dried. Leaves spirally arranged or distichous, exceptionally in pseudowhorls. Flowers not or mostly only faintly fragrant. Seeds and embryo straight or curved. *Spp.* 3–58 2. subg. *Hopea*

1. subg. *Symplocos*

1. Subgenus *Symplocos*

Cf. NOOT. Leid. Bot. Ser. 1 (1975) 36. — *Cordyloblaste* MOR. Bot. Zeit. 6 (1848) 606; RIDL. Fl. Mal. Pen. 2 (1923) 307; ALSTON, Handb. Fl. Ceyl. 6 (Suppl.) (1931) 186. — *Symplocos* sect. *Cordyloblaste* B. & H. Gen. Pl. 2 (1876) 669; BRAND, Pfl. R. Heft 6 (1901) 88; STEEN. Bull. Bot. Gard. Btzg III, 17 (1948) 429. — *Symplocos* subg. *Cordyloblaste* GAMBLE, J. As. Soc. Beng. 74, ii (1906) 248. — Fig. 6.

Leaves usually not becoming yellow when dry. Corolla tubular, erect, often to above the middle adherent to the staminal tube and then suddenly expanded;

margins of the petals free, thus sometimes obscuring the coalescence. Stamens monadelphous; free part of filaments ribbon-shaped, in several whorls, in the outer whorl often very short, always suddenly attenuate below the anther. Fruits 2–5-celled, usually none of the cells aborted. Seeds straight, cylindrical.

Distr. Tropics of Indo-Malesia and South America, largely within 30° N and S, more than 100 spp. described from the New World, in *Malesia* 2 spp. Fig. 1.

Ecol. Rain-forest, from the lowland up to c. 3300 m (Mt Kinabalu).

KEY TO THE SPECIES

1. Calyx c. 6(–10) mm long. Corolla $2\frac{1}{2}$ –5 cm long. Fruits 3–5 cm long 1. *S. henschelii*
1. Calyx 3–5 mm long. Corolla $\frac{1}{2}$ – $1\frac{3}{4}$ cm long. Fruits 1– $1\frac{1}{2}$ cm long 2. *S. pendula*

1. *Symplocos henschelii* (MOR.) BTH. ex CLARKE, Fl. Br. Ind. 3 (1882) 588, *quoad nomen et basionym, excl. stirp.*; BRAND, Pfl. R. Heft 6 (1901) 89; Bull. Herb. Boiss. II, 6 (1906) 750; KOORD. Atlas 2 (1914) t. 390; STEEN. Bull. Bot. Gard. Btzg III, 17 (1948) 440, f. 2 a–l; Nova Guinea n.s. 10 (1959) 210; BACK. & BAKH. f. Fl. Java 2 (1965) 204; STEEN. Mt. Fl. Java (1972) pl. 52–3; NOOT. Leid. Bot. Ser. 1 (1975) 37, pl. 1g. — *Cordylolabste henscheli* MOR. Bot. Zeit. 6 (1848) 606. — *Eugeniodes henscheli* O. K. Rev. Gen. Pl. 2 (1891) 975. — *S. nageli* K. & V. Bijdr. 7 (1900) 159. — *S. scortechinii* KING & GAMBLE, J. As. Soc. Beng. 74, ii (1906) 250. — *Cordylolabste scortechinii* RIDL. Fl. Mal. Pen. 2 (1923) 309. — *S. dolichantha* MERR. Sar. Mus. J. 3 (1928) 545. — *S. stenosepala* STEEN. Bull. Bot. Gard. Btzg III, 17 (1948) 444, f. 2 m–n. — Fig. 6a–c.

For further synonyms see under the variety.

Shrub, or mostly a tree, to 30 m; innovations glabrous to grey or rusty velvety. Leaves glabrous, sometimes the midrib above and underside hairy, 7–17(–22) by 3– $7\frac{1}{2}$ cm; petiole $\frac{1}{2}$ – $1\frac{1}{2}$ (–2) cm. Racemes up to 10 cm, incl. bracts and flowers grey or rusty tomentose, short-peduncled, 1–12-flowered. Bracts narrow-triangular; pedicels 0–6 mm, with 2(–3) tiny bracteoles. Calyx lobes rounded to triangular, mostly erect, 1– $4\frac{1}{2}$ by 2–3 mm, persistent. Corolla sericeous (in Mal.), club-shaped in bud, $2\frac{1}{2}$ –5 cm, connate for $\frac{3}{5}$ – $\frac{3}{4}$, tube 3–4 mm \varnothing , lobes spatulate. Staminal tube $\frac{1}{2}$ cm shorter than corolla, adnate to the corolla tube except towards apex, free part $\frac{1}{2}$ – $1\frac{1}{2}$ cm; anthers 20–110, filaments unequal. Ovary 3–4-celled; ovules 2–4 per cell, usually only 1 developing. Fruit obovoid to spindle-shaped, 3–5 by 2–3 cm; mesocarp thick, hard-fleshy to \pm woody.

Distr. Continental SE. Asia (Burma, Thailand, Indo-China) and West Malesia (Sumatra, Malay Peninsula, W. Java, Borneo), a distinct subspecies in Thailand.

Note. Additional material has shown that *S. stenosepala* STEEN. cannot be upheld and, moreover, that *S. maingayi* CLARKE deserves only varietal rank.

KEY TO THE VARIETIES

1. Leaves and twig ends usually glabrous. Free part of staminal tube 7–15 mm. a. var. *henschelii*
1. Twig ends and leaves underneath hairy. Free part of staminal tube 5–7 mm b. var. *maingayi*

a. var. *henschelii*. — Fig. 6a–b.

Shrub or tree, up to 25 m, 45 cm \varnothing . Twigs glabrous, the youngest ones sometimes more or less grey or rufescent appressedly pubescent to velvety or tomentose. Leaves glabrous, or the midrib beneath sparsely short fine-hairy, rarely with same indument as var. *maingayi*. Free part of staminal tube 7–15 mm; anthers (40–)55–75(–110), in the upper 5–10 mm, ascendent and nearly sessile above to descendent on a slender filament below, the lowest ones hanging from a 2–5 mm long filament. Fruit with \pm fleshy mesocarp.

Distr. As the species.

Ecol. Below 1100 m in mixed dipterocarp forest, also once in swamp forest, and on podsol (Kalabit), at higher altitude in oak-chestnut mountain forest, also on ridges and in mossy forest, 600–2000 m (in continental SE. Asia at 130–800 m). Fl. Jan.–Dec., fr. Febr.–Sept.

Vern. Sumatra: kayu djaram-djaram bosi, Batak; Borneo: tē baradang, Sarawak, Kalabit, yum, Kenyah lang., lamau-lamau, Brunei.

b. var. *maingayi* (CLARKE) NOOT. Leid. Bot. Ser. 1 (1975) 39. — *S. maingayi* BTH. ex CLARKE, Fl. Br. Ind. 3 (1882) 588; BRAND, Pfl. R. Heft 6 (1901) 90; K. & G. J. As. Soc. Beng. 72, ii (1906) 249; STEEN. Bull. Bot. Gard. Btzg III, 17 (1948) 445. — *Eugeniodes maingayi* O. K. Rev. Gen. Pl. 2 (1891) 975. — *Cordylolabste maingayi* RIDL. Fl. Mal. Pen. 2 (1923) 309. — Fig. 6c.

Tree up to 21 m, 40 cm \varnothing . Twigs densely rusty tomentose or velvety, glabrescent. Leaves sparsely fine-hairy beneath, especially on midrib and nerves, to greyish tomentose or velvety. Free part of staminal tube 5–7 mm; anthers 20–60, in the upper 5 mm, on a very short ($\frac{1}{4}$ – $\frac{1}{2}$ mm) thin free part of the filaments. Fruit with \pm woody mesocarp.

Distr. Malesia: Malay Peninsula and Borneo (Sarawak, Brunei).

Ecol. Evergreen primary and depleted lowland forest, 15–150 m; in Borneo often on low sandy ridges, raised beaches, and large sandy podsols (kerangas). Fl. April–May, fr. Jan.

2. *Symplocos pendula* WIGHT, Ic. 4 (1848) 10, t. 1237; Ill. Ind. Bot. 2 (1850) t. 151–b, 7–12; CLARKE, Fl. Br. Ind. 3 (1882) 587; BRAND, Pfl. R. Heft 6 (1901) 88; STEEN. Bull. Bot. Gard. Btzg III, 17 (1948) 437; NOOT. Leid. Bot. Ser. 1 (1975) 40, pl. 1h. — *S. scortechinii* (non K. & G.) RIDL. J. Linn. Soc. Bot. 38 (1908) 315. — *S. pulcherrima*

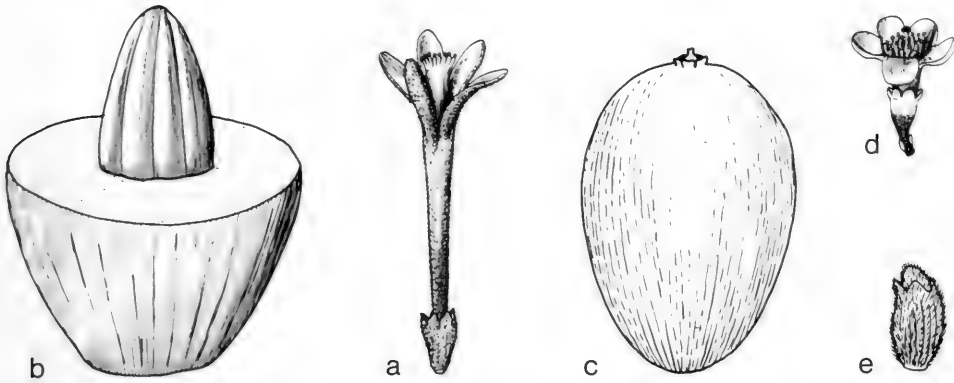


Fig. 6. *Symplocos henschelii* (MOR.) BTH. ex CLARKE var. *henschelii*. a. Flower, b. fruit, exocarp halved. — *S. henschelii* var. *maingayi* (CLARKE) NOOT. c. Fruit. — *S. pendula* WIGHT var. *pendula*. d. Flower. — *S. pendula* var. *hirtistylis* (CLARKE) NOOT. e. Fruit. All nat. size (a WILSON 2547, b after STEEN. 1972, pl. 52–3b, c KOSTERMANS 9328, d father ANGLADE s.n., e MEIJER 3618).

RIDL. J. Fed. Mal. St. Mus. 6 (1915) 160. — *Cordylolabste pulcherrima* RIDL. Fl. Mal. Pen. 2 (1923) 308. — Fig. 6d–e.

For further synonyms see under the variety.

var. *pendula*. — Fig. 6d.

Small shrub $1\frac{1}{2}$ –3 m or tree up to 27 m and 50 cm Ø. Twigs glabrous to rusty tomentose. Leaves glabrous or nearly so, elliptic to obovate or orbicular, entire to crenate, apex rounded to acuminate, $(1\frac{1}{2})$ – $2\frac{1}{2}$ – $12\frac{1}{2}$ by $(1\frac{1}{2})$ – $1\frac{1}{2}$ –6 cm; nerves 4–8(–11) pairs; petiole (1)–5–15 mm. Racemes very short, sometimes flowers solitary. Bracts to 1 mm. Bracteoles 2–4, narrow-triangular. Pedicels 0–5 mm, longer in solitary flowers. Calyx lobes very short and rounded, ciliate. Corolla tubular-trumpet-shaped, (5–)10–17 mm, fleshy, silver-white to creamy, fragrant, the petals connate halfway up, spatulate, rounded at apex, glabrous to tomentose. Staminal tube adnate to corolla except for upper 3–5 mm, hairy to glabrous inside; anthers 30–50 (–80). Ovary semi-inferior, glabrous, the apex semi-globose, c. $1\frac{1}{2}$ mm high, densely grey-hairy; style c. 1 cm, more or less hairy at the base to glabrous at the apex. Fruits spindle-shaped, 10–15 by 3–6 cm, green pinkish red, the enlarged calyx lobes surrounding the hairy, conical, persistent style-base.

Distr. Continental SE. Asia (Ceylon, Deccan, Hainan), in *Malesia*: Malay Peninsula.

Ecol. Mountain forests and open heath and scrub, often on ridges, 600–1750 m. Fl. Febr.–March, fr. Sept.

var. *hirtistylis* (CLARKE) NOOT. Leid. Bot. Ser. 1

(1975) 42, f. 2a, with full synonymy. — *S. henschelii* (non BTH.) CLARKE, Fl. Br. Ind. 3 (1882) 588, *pro stirp.*, incl. var. *hirtistylis* CLARKE. — *S. confusa* BRAND, Pfl. R. Heft 6 (1901) 88; Bull. Herb. Boiss. II, 6 (1906) 750; K. & G. J. As. Soc. Beng. 74, ii (1906) 248; BRAND, Philip. J. Sc. 3 (1903) Bot. 3; MERR. En. Philip. 3 (1923) 297; STEEN. J. Arn. Arb. 28 (1947) 423; Bull. Bot. Gard. Botz III, 17 (1948) 432. — *S. albifrons* BRAND, Pfl. R. Heft 6 (1901) 88; Bull. Herb. Boiss. II, 6 (1906) 750; Nova Guinea 14 (1924) 189. — *S. capitellata* BRAND, Pfl. R. Heft 6 (1901) 88; Bull. Herb. Boiss. II, 6 (1906) 750; Nova Guinea 14 (1924) 188. — *S. foxworthyi* BRAND, Philip. J. Sc. 3 (1908) Bot. 3; MERR. En. Philip. 3 (1923) 299. — *Styrax obovatus* RIDL. J. Str. Br. R. As. Soc. n. 61 (1912) 8. — *S. obovata* RIDL. J. Fed. Mal. St. Mus. 6 (1915) 51. — *S. crenulata* RIDL. l.c. — *S. novoguineensis* GIBBS, Arfak (1917) 176. — *Cordylolabste obovata* RIDL. Fl. Mal. Pen. 2 (1923) 308. — *Cordylolabste crenulata* RIDL. l.c. 309. — *S. atrata* BRAND, Nova Guinea 14 (1924) 188. — *S. topica* BRAND, l.c. 189. — Fig. 6e.

Ovary hairy.

Distr. Continental SE. Asia (N. Burma, Indo-China, China, Japan, Formosa), throughout *Malesia*, except Java and Lesser Sunda Is.

Ecol. Primary and secondary montane and sub-alpine forest, mossy forest, often common on ridges, or in open fern thickets (Tamrau), on sand or clay, 1500–3300 m, but in kerangas forest in Sarawak at 800 m. Fl. March–Aug. (Sept.–Febr.), fr. Febr.–April, July–Sept.

At higher altitude often a dwarf shrub with small leaves, but sometimes also a dwarf shrub with large leaves in high forest.

2. Subgenus *Hopea*

CLARKE, Fl. Br. Ind. 3 (1882) 572; BRAND, Pfl. R. Heft 6 (1901) 25; NOOT. Leid. Bot. Ser. 1 (1975) 43, with full synonymy. — *Hopea* LINNÉ, Mant. (1767) 105, *nom.*

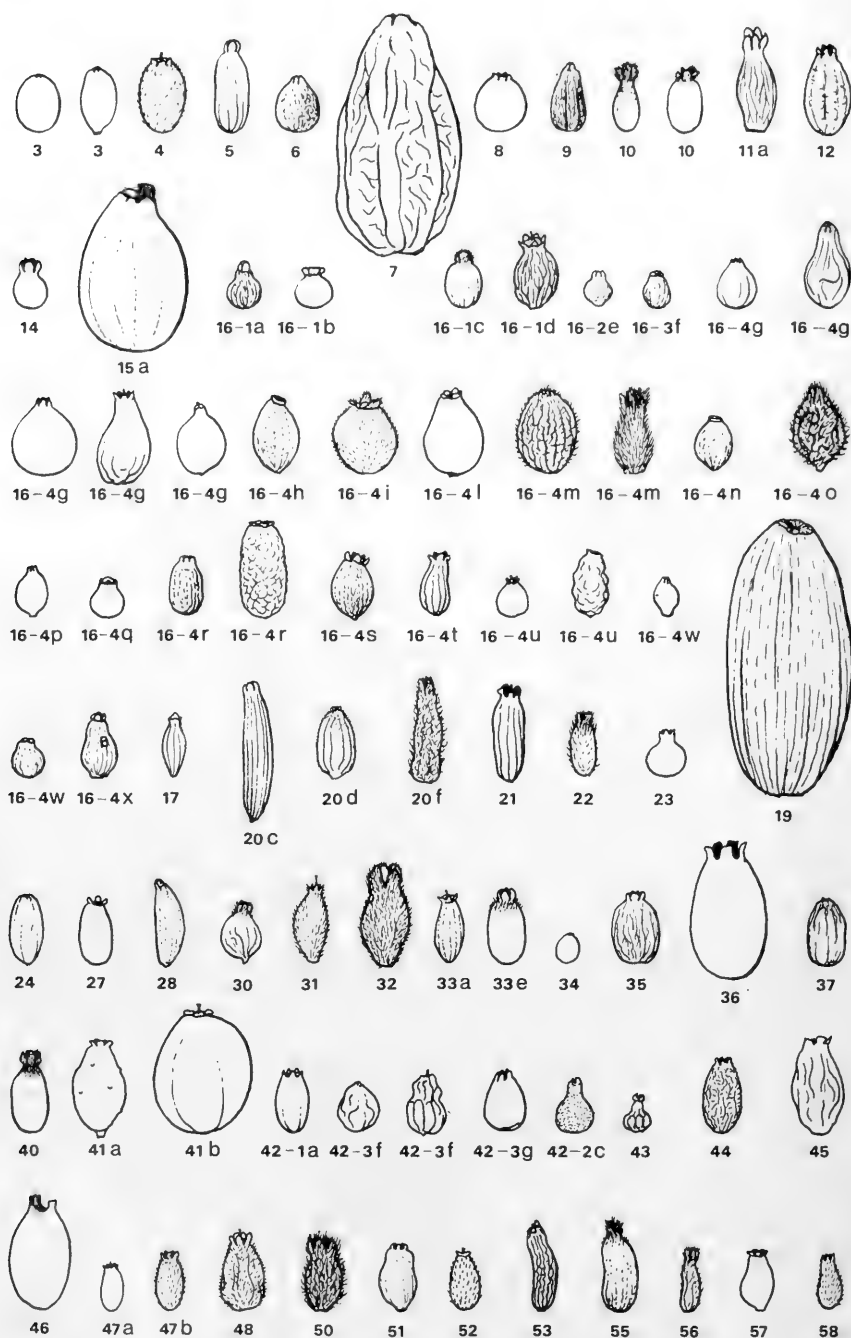


Fig. 7. Fruits in outline, in the dried state. Of each fruit the voucher specimen is cited by the number of the taxon. If for showing variability more fruits of the same taxon are drawn, read from left to right corresponding with the voucher numbers. All drawings natural size. — 3 CHEW WEE LEK 938 — 3 CF 104879 — 4 SAN 56690 — 5 DE WILDE 13773 — 6 A. ERNST 736 — 7 KING'S Coll. 6179 — 8 MEIJER 7581 — 9

rejic. — *Dicalix* LOUR. Fl. Coch. 1 (1790) 663; BL. Bijdr. (1826) 1116 ('*Dicalyx*'). — *Sariava* REINW. Syll. Ratisb. 2 (1825) 12. — *Carlea* PR. Epim. Bot. (1851) 216. — *Baranda* LLANOS, Mem. Ac. Cien. Madrid 3, 2 (1857) 502. — *Eugeniodes* O. K. Rev. Gen. Pl. 2 (1891) 409, 975, *nom. illeg.* — **Fig. 7-20.**

Leaves usually becoming more or less yellow when drying. Petals glabrous, or hairy in only few species, connate only at the very base, mostly expanded. Stamens monadelphous to pentadelphous, only connate at the very base (for at most 2 mm); filaments cylindrical, slender to rather stiff, often gradually attenuate towards the anther. Fruits 2-3(-5?)-celled, often 1-celled by abortion. Seeds either straight or curved, and then with curved embryo.

Distr. About 150 *spp.*, as for the genus. Fig. 1.
Note. As explained in the note under the genus, a general overall key is given to all species, as much as possible based on vegetative characters and on flowering material.
To facilitate identification additional local keys are given for the main Malesian islands or island groups, one each for flowering and for fruiting material.
In addition in fig. 7 fruits are drawn of all species as far as available in the *dried state*. They have been numbered according to the number of the taxa. The following terminology has been adopted for fruit-shapes:

globose 34, 41b	ampulliform 23, 42c, 43
ellipsoid 4, 19, 33e, 46	spindle-shaped 38: fig. 19d.
ovoid 48	cylindrical 20c, 21
obovoid 1a, 1b: fig. 6c	

It should be observed that the shape of the stone may differ from the shape of the fruit and that for instance ovoid fruits may possess an ampulliform stone.
There is no strict relation between the shape of the seed and the shape of the fruit or stone, but ampulliform fruits have always a curved seed and curved embryo and spindle-shaped and cylindrical fruits have always a straight seed and embryo.
Besides the overall-shape of the drupe, the shape of the stone can be important: sometimes it bears lower or higher ridges, which ornamentation provides good characters.

KEY TO THE SPECIES

1. Leaves (pseudo-)verticillate.

2. Upper side of leaves glabrous. Twigs hirsute 55. *S. verticillifolia*

2. Upper side of leaves hairy. Twigs tomentose 30. *S. herzogii*
1. Leaves not verticillate.

3. Midrib prominent on the upper surface.

4. Twigs glabrous.

5. Leaves crowded towards the end of the twigs, minutely appressedly hairy beneath

37. *S. wikstroemifolia*

5. Leaves evenly distributed, glabrous 35. *S. lucida*

4. Twigs hairy.
- HALLIER f. 2197 — 10 CLEMENS 32525 — 10 CLEMENS 32478 — 11a bb 23324 — 12 SAN 46543 — 14 KOSTERMANS 9158 — 15a KOSTERMANS & ANTA 527 — 16-1a FORBES 861 — 16-1b MEIJER 1690 — 16-1c CLEMENS 17224 — 16-1d BS 4476 — 16-2c LARSEN c.s. 887 — 16-3f NGF 33643 — 16-4g ANU 2027 — 16-4g A. C. SMITH 1054 — 16-4g BW 4970 — 16-4g GILLESPIE 3918 — 16-4g NGF 28481 — 16-4h VINK 17308 — 16-4i BRASS 28343 — 16-4i BRASS 29919 — 16-4m LEDERMANN 8946 — 16-4m T. G. HARTLEY 13135 — 16-4n PULLEN 479 — 16-4o NGF 49168 — 16-4p PULLEN 7783 — 16-4q KOSTERMANS & WIRAWAN 878 — 16-4r NICOLAS 19 — 16-4r VAN BALGOOY 862 — 16-4s KALKMAN 5128 — 16-4t VINK 16079 — 16-4u KOSTERMANS 2375 — 16-4u FORBES P. P. 652 — 16-4w BRASS 28191 — 16-4w CLEMENS 1661 — 16-4x NGF 23728 — 17 CLEMENS 33706 — 19 KOORDERS 15596 — 20c VAN BEUSEKOM c.s. 837 — 20d ENDERT 2580 — 20f CF 97832 — 21 bb 22503 — 22 JACOBS 5766 — 23 SAN A2240 — 24 MERRILL 6148 — 27 BS 45592 — 28 KEP/FRI 8236 — 30 T. G. HARTLEY 12509 — 31 NOOTEBOOM & ABAN 1500 — 32 HILDEBRAND 55 — 33a SAN 65017 — 33c SAN 44386 — 34 PNH 18483 — 35 BÜRGER s.n. — 36 Cel. II-374 — 37 F. C. HOW 73506 — 40 BS 26447 — 41a Ja 7723 — 41b SAN 57045 — 42-1a BURN MURDOCH 340 — 42-3f DING HOU 274 — 42-3f NOOTEBOOM 2229 — 42-3g BS 83753 — 42-2c CF 98890 — 43 KAJEWSKI 1208 — 44 S 17287 — 45 CARR 12782 — 46 RIDLEY 16102 — 47a ROBINSON & KLOSS 199 — 47b MEIJER 7665 — 48 ISMAEL 9 — 50 BECCARI P. S. 106 — 51 KOELZ 29538 — 52 CLEMENS 32559 — 53 S 26305 — 55 PNH 14397 — 56 BS 45675 or 45775 — 57 JACOBS 7484 — 58 NOOTEBOOM 1491.

6. Leaves crowded towards the end of the twigs, minutely appressedly hairy beneath
 37. *S. wikstroemifolia*
6. Leaves evenly distributed, glabrous or sparsely fine hairy beneath.
 4. *S. anomala*
7. Underside of leaves glabrous. Corolla 4–6 mm
 34. *S. lancifolia*
7. Underside of leaves hairy. Corolla 2½–4 mm
 41. *S. odoratissima*
3. Midrib sulcate above.
 41. *S. odoratissima*
8. Corolla (densely) hairy
 41. *S. odoratissima*
8. Corolla glabrous.
 41. *S. odoratissima*
9. Twigs hairy.
 10. Underside of leaves glabrous. (When petiole and leaf margin beset with closely spaced vesicular glands: 3. *S. adenophylla*).
 11. Leaves distichous
 33. *S. laeteviridis*
 11. Leaves spirally arranged.
 12. Calyx and ovary glabrous.
 13. Petiole 0–5 mm
 - 16–4. *S. cochinchinensis* ssp. *leptophylla*
 13. Petiole more than 5 mm.
 - 16–4. *S. cochinchinensis* ssp. *leptophylla*
 14. Leaves shorter than 5 cm
 - 16–4. *S. cochinchinensis* ssp. *leptophylla*
 14. Leaves longer than 5 cm.
 - 16–4. *S. cochinchinensis* ssp. *leptophylla*
 15. Disk hairy
 - 16–4. *S. cochinchinensis* ssp. *leptophylla*
 15. Disk glabrous.
 16. Twigs (appressedly) pubescent, puberulous or pilose. Seeds not straight.
 16. *S. cochinchinensis*
 16. Twigs tomentose or tomentellous.
 17. Petiole 12–17 mm. Acumen 2–7 mm long. Nerves 8–12 pairs. Fruits more than 10 mm long
 5. *S. atjehensis*
 17. Petiole 5–12 mm. Acumen longer than 7 mm. Nerves 10–16 pairs. Fruits to c. 10 mm long.
 28. *S. glomerata*
 12. Calyx and/or ovary hairy.
 18. Leaves crowded towards the end of the twigs, the latter tapering off towards the apex.
 44. *S. polyandra*
 18. Leaves evenly distributed, twigs not obviously tapering off.
 19. Ovary glabrous.
 20. Inflorescence only 1-flowered
 38. *S. multibracteata*
 20. Inflorescence more-flowered.
 21. Disk hairy
 - 16–4. *S. cochinchinensis* ssp. *leptophylla*
 21. Disk glabrous.
 22. Seed and embryo uncinately curved towards the base
 - 16–4. *S. cochinchinensis* ssp. *leptophylla*
 22. Seed and embryo twice curved
 - 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
 19. Ovary hairy.
 23. Calyx glabrous
 - 16–4. *S. cochinchinensis* ssp. *leptophylla*
 23. Calyx hairy.
 24. Bracts caducous.
 25. Inflorescence an often branched raceme to 4 cm. Calyx 1–2 mm long
 47. *S. robinsonii*
 25. Inflorescence a 1–3-flowered short spike. Calyx c. 3 mm
 10. *S. brachybotrys*
 24. Bracts persistent.
 26. Petiole 0–5 mm
 - 16–4. *S. cochinchinensis* ssp. *leptophylla*
 26. Petiole more than 5 mm.
 27. Seeds straight
 24. *S. filipes*
 27. Seeds not straight.
 - 16–4. *S. cochinchinensis* ssp. *leptophylla*
 10. Underside of leaves hairy.
 28. Leaves distichous.
 29. Nerves up to 6 pairs.
 30. Angle of leaf base more than 90°
 31. *S. johniana*
 30. Angle of leaf base less than 90°.
 31. Disk glabrous
 52. *S. trichomarginalis*
 31. Disk hairy
 33. *S. laeteviridis*
 29. Nerves (5–)6 pairs or more.
 32. Leaves longer than 5 cm (mean length).
 33. Flowers c. 3 in an up to 3 cm long lax raceme. Fruits 10–14 mm long. Stamens c. 90 or more.
 17. *S. colombonensis*
 33. Inflorescence usually different. Fruits to c. 12 mm long. Stamens c. 70 or less.
 34. Inflorescence a fascicle. Bracts to c. 1 mm long, persistent, bracteoles persistent. Ovary c. 1 mm high, calyx c. 1 mm long, lobes not becoming longer by tearing. Corolla c. 2–4½ mm. Style base hairy. Fruits ampulliform
 23. *S. fasciculata*
 34. Inflorescence not a fascicle. Bracts longer than 1 mm, caducous, bracteoles caducous. Ovary more than 1 mm high, calyx longer than 1 mm, lobes becoming longer by tearing. Corolla more than 4 mm long. Style base glabrous. Fruits ovoid to ellipsoid
 33. *S. laeteviridis*

32. Leaves shorter than 5 cm.
 35. Inflorescence only 1-flowered.
 36. Reticulation not prominent. Ovary c. 1 mm high, calyx longer than 2 mm, lobes c. 3 mm. Bracts several. Corolla c. 4 mm. Fruits 8–9 mm long 52. *S. trichomarginalis*
 36. Reticulation present beneath. Ovary 1–1½ mm high, calyx c. 2 mm long, lobes 1–1½ mm long. Bract 1. Corolla 4–6 mm long. Fruits 10–12 mm long 58. *S. zizyphoides*
 35. Inflorescence more-flowered.
 37. Bracts and bracteoles caducous 33. *S. laeteviridis*
 37. Bracts and bracteoles persistent.
 38. Disk hairy. Fruits c. 10 by 5 mm 22. *S. deflexa*
 38. Disk glabrous. Fruits 10–12 by 5–6 mm. 58. *S. zizyphoides*
 28. Leaves spirally arranged.
 39. Upper side of leaves hairy.
 40. Angle of leaf base more than 90°. 13. *S. calycodactylos*
 40. Angle of leaf base less than 90°.
 41. Leaf margin (and petiole) beset with closely spaced glands 3. *S. adenophylla*
 41. Leaf margin (and petiole) often glandular but glands not closely spaced.
 42. Ovary hairy. Fr. cylindrical, 13–18 by 3–5 mm. Embryo straight 20. *S. crassipes*
 42. Ovary glabrous. Fr. ampulliform, 6 by 4 mm. Embryo twice curved 43. *S. paucistaminea*
 39. Upper side of leaves glabrous.
 43. Calyx and ovary glabrous.
 44. Leaves crowded towards the end of the twigs, minutely appressedly hairy beneath 37. *S. wikstroemifolia*
 44. Leaves evenly distributed, glabrous or longer hairs beneath.
 45. Seeds straight.
 46. Leaf index 2–3. Fruits less than 20 mm long 5. *S. atjehensis*
 46. Leaf index more than 3. Fruits longer than 20 mm.
 47. Nerves less than 10 pairs 15. *S. cerasifolia*
 47. Nerves more than 10 pairs 15b. *S. cerasifolia* var. *grandifolia*
 45. Seeds not straight 16–4. *S. cochinchinensis* ssp. *leptophylla*
 43. Calyx and/or ovary hairy.
 48. Leaves crowded towards the end of the twigs 37. *S. wikstroemifolia*
 48. Leaves evenly distributed.
 49. Ovary glabrous.
 50. Disk hairy.
 51. Inflorescence only 1-flowered. Seeds straight. 38. *S. multibracteata*
 51. Inflorescence more-flowered. Seeds not straight.
 52. Petiole 0–5 mm 34. *S. lancifolia*
 52. Petiole more than 5 mm 16–4. *S. cochinchinensis* ssp. *leptophylla*
 50. Disk glabrous.
 53. Ovary to c. 1 mm high 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
 53. Ovary more than 1 mm high.
 54. Twigs (appressedly) pubescent, puberulous or pilose. 16–4. *S. cochinchinensis* ssp. *leptophylla*
 54. Twigs not appressedly pubescent or puberulous.
 55. Leaf index 2–3. Bracts persistent, shorter than 3 mm, bracteoles persistent. Calyx lobes not becoming longer by tearing. Corolla shorter than c. 4 mm. Stamens less than 30. Fruits to c. 10 mm long. Mesocarp fleshy (shrivelled when dry). Seeds not straight. 16–4. *S. cochinchinensis* ssp. *leptophylla*
 55. Leaf index more than 3. Bracts caducous, longer than 3 mm, bracteoles caducous. Calyx lobes becoming longer by tearing. Corolla c. 5 mm long. Stamens more than 30. Fruits more than 20 mm long. Mesocarp woody or corky. Seeds straight 15. *S. cerasifolia*
 49. Ovary hairy.
 56. Calyx glabrous 16–4. *S. cochinchinensis* ssp. *leptophylla*
 56. Calyx hairy.
 57. Bracts caducous.
 58. Leaves longer than 15 cm.
 59. Fruits more than 10 mm long, 2–5-celled. Mesocarp woody or corky. Stone with high lengthwise not interrupted ridges. Seeds straight 15b. *S. cerasifolia* var. *grandifolia*
 59. Fruits to c. 10 mm long, 1-celled. Mesocarp thin, friable in dry state. Stone with a transverse constriction at one side. Seeds not straight 48. *S. rubiginosa*
 58. Leaves shorter than c. 15 cm.
 60. Calyx lobes longer than 1½ mm. Style base hairy.
 61. Leaves shorter than 5 cm 10. *S. brachybotrys*
 61. Leaves longer than 5 cm.
 62. Inflorescence a raceme 50. *S. sumatrana*
 62. Inflorescence a 1–3-flowered short spike or a spike to 4 cm.

63. Petiole 3–4 mm. Ovary *c.* 1 mm high, calyx *c.* 3 mm, lobes longer than 2½ mm. Ovary (appressedly) pubescent. Disk inconspicuous. Fruits *c.* 5 mm broad, 1-celled. Seeds not straight 10. *S. brachybotrys*
63. Petiole 5–7 mm. Ovary *c.* 1½ mm high, calyx 2 mm long, lobes 1½–2½ mm long. Ovary sericeous. Disk clearly present. Fruits more than 5 mm broad, 3-celled. Seeds straight 50. *S. sumatrana*
60. Calyx lobes ½–1½ mm long. Style base glabrous.
64. Nerves more than 10 pairs 47. *S. robinsonii*
64. Nerves less than 10 pairs.
65. Ovary *c.* 1 mm high, lobes triangular. 42–1b. *S. ophirensis* var. *densireticulata*
65. Ovary 1–2 mm high, lobes not triangular. 47. *S. robinsonii*
57. Bracts persistent.
66. Inflorescence only 1-flowered.
67. Angle of leaf base more than 90° 31. *S. johniana*
67. Angle of leaf base less than 90°.
68. Leaf index 4–7. Ovary *c.* 1¼ mm high. Stamens less than 30. Disk hairy, inconspicuous. Stone ?smooth 49. *S. salicioides*
68. Leaf index 1.3–4. Ovary to *c.* 1 mm high. Stamens more than 30. Disk glabrous, clearly present. Stone with ridges or grooves 20. *S. crassipes*
66. Inflorescence more-flowered.
69. Seeds straight.
70. Bracts to *c.* 1 mm long.
71. Ovary to *c.* 1 mm high.
72. Reticulation fine. Calyx longer than 1 mm. Inflorescence a much reduced often clustered spike. Fruits not ampulliform, 13–18 mm long 20. *S. crassipes*
72. Reticulation coarse. Calyx *c.* 1 mm long. Inflorescence a fascicle. Fruits ampulliform, 5–7 mm long 23. *S. fasciculata*
71. Ovary more than 1 mm high.
73. Leaf index more than 3. Calyx lobes longer than ½ mm 3. *S. adenophylla*
73. Leaf index 2–3. Calyx lobes to *c.* ½ mm long 24. *S. filipes*
70. Bracts longer than 1 mm.
74. Angle of leaf base more than 90° 20. *S. crassipes*
74. Angle of leaf base less than 90°.
75. Underside of leaves especially hairy on the margin 20. *S. crassipes*
75. Underside of leaves not especially hairy on the margin.
76. Calyx lobes longer than 1½ mm. Disk hairy. Stamens more than 30. Style base hairy. Fruits more than 10 mm long 20. *S. crassipes*
76. Calyx lobes 1–1½ mm long. Disk glabrous. Stamens less than 30. Style base glabrous. Fruits *c.* 10 mm long 56. *S. vidalii*
69. Seeds not straight.
77. Disk glabrous 16–4. *S. cochinchinensis* ssp. *leptophylla*
77. Disk hairy.
78. Seed and embryo U-shaped 34. *S. lancifolia*
78. Seed and embryo uncinately curved towards the base. 16–4. *S. cochinchinensis* ssp. *leptophylla*
9. Twigs glabrous.
79. Underside of leaves hairy.
80. Leaves crowded towards the end of the twigs, minutely appressedly hairy beneath 37. *S. wikstroemifolia*
80. Leaves evenly distributed.
81. Calyx and ovary glabrous.
82. Disk hairy 16–4. *S. cochinchinensis* ssp. *leptophylla*
82. Disk glabrous.
83. Seed and embryo uncinately curved towards the base. 16–4. *S. cochinchinensis* ssp. *leptophylla*
83. Seed and embryo not uncinately curved towards the base 5. *S. atjehensis*
81. Calyx and/or ovary hairy.
84. Leaves distichous 33. *S. laeteviridis*
84. Leaves spirally arranged.
85. Leaves shorter than 5 cm 10. *S. brachybotrys*
85. Leaves longer than 5 cm.
86. Calyx glabrous.
87. Calyx lobes becoming longer by tearing. Seeds straight 20. *S. crassipes*
87. Calyx lobes not becoming longer by tearing. Seeds not straight. 16–4. *S. cochinchinensis* ssp. *leptophylla*
86. Calyx hairy.
88. Petiole 3–4 mm 10. *S. brachybotrys*
88. Petiole more than 5 mm.
89. Ovary glabrous 16–4. *S. cochinchinensis* ssp. *leptophylla*

89. Ovary hairy.
90. Bracts and bracteoles caducous 48. *S. rubiginosa*
90. Bracts and bracteoles persistent.
91. Bracts to c. 1 mm long. Seeds straight 24. *S. filipes*
91. Bracts longer than 1 mm. Seeds not straight. 16-4. *S. cochinchinensis* ssp. *leptophylla*
79. Underside of leaves glabrous.
92. Leaves distichous 33. *S. laeteviridis*
92. Leaves spirally arranged.
93. Calyx and/or ovary hairy.
94. Ovary glabrous.
95. Bracts caducous.
96. Leaves shorter than 5 cm 12. *S. buxifolia*
96. Leaves 9-15 cm 21. *S. cylindracea*
96. Leaves longer than 15 cm 7. *S. barringtoniifolia*
95. Bracts persistent.
97. Inflorescence only 1-flowered 12. *S. buxifolia*
97. Inflorescence more-flowered.
98. Disk hairy 16-4. *S. cochinchinensis* ssp. *leptophylla*
98. Disk glabrous.
99. Calyx lobes to c. $\frac{1}{2}$ mm long 16-4. *S. cochinchinensis* ssp. *leptophylla*
99. Calyx lobes longer than $\frac{1}{2}$ mm.
100. Ovary to c. 1 mm high 16. *S. cochinchinensis*
100. Ovary more than 1 mm high.
101. Seeds straight 42. *S. ophirensis*
101. Seeds not straight.
102. Seed and embryo uncinately curved towards the base. 16-4. *S. cochinchinensis* ssp. *leptophylla*
102. Seed and embryo different 42. *S. ophirensis*
94. Ovary hairy.
103. Leaves shorter than 5 cm. Petiole 3-4 mm 10. *S. brachybotrys*
103. Leaves longer than 5 cm.
104. Calyx glabrous.
105. Disk glabrous.
106. Calyx lobes not becoming longer by tearing. Seeds not straight. 16-4. *S. cochinchinensis* ssp. *leptophylla*
106. Calyx lobes becoming longer by tearing. Seeds straight 20. *S. crassipes*
105. Disk hairy.
107. Seeds not straight. Bracts and bracteoles persistent. 16-4. *S. cochinchinensis* ssp. *leptophylla*
107. Seeds straight. Bracts and bracteoles caducous.
108. Corolla 5-6 mm 21. *S. cylindracea*
108. Corolla 8-10 mm 32. *S. junghuhnii*
104. Calyx hairy.
109. Bracts caducous.
110. Calyx longer than 1 mm. Style base hairy.
111. Petiole 3-4 mm. Inflorescence a (basally branched) spike. Ovary c. 1 mm high. Disk inconspicuous. Fruits c. 10 mm long, 1-celled. Seeds not straight 10. *S. brachybotrys*
111. Petiole more than 5 mm. Inflorescence a panicle. Ovary 1-1 $\frac{1}{2}$ mm high. Disk clearly present. Fruits 15 mm long, 3-celled. Seeds straight 21. *S. cylindracea*
110. Calyx to c. 1 mm long. Style base glabrous 42. *S. ophirensis*
109. Bracts persistent.
112. Petiole 0-5 mm 42. *S. ophirensis*
112. Petiole more than 5 mm.
113. Leaves crowded towards the end of the twigs, the latter tapering off, at least 5 mm \varnothing beneath the leaves 44. *S. polyandra*
113. These characters not combined.
114. Nerves 13-20 pairs. Intramarginal vein absent. Leaves 21-62 cm 26. *S. gigantifolia*
114. Nerves 4-13 pairs. Leaves 4-23 cm.
115. Disk glabrous.
116. Bracts longer than 1 mm 16-4. *S. cochinchinensis* ssp. *leptophylla*
116. Bracts to c. 1 mm long.
117. Calyx lobes to c. $\frac{1}{2}$ mm long. Stone with low ridges 24. *S. filipes*
117. Calyx lobes longer than $\frac{1}{2}$ mm. Stone with high lengthwise interrupted ridges. 42. *S. ophirensis*
115. Disk hairy.
118. Nerves 4-7 pairs. Fruits ampulliform with long beak, c. 7 by 5 mm 42. *S. ophirensis*
118. These characters not combined 16-4. *S. cochinchinensis* ssp. *leptophylla*

93. Calyx and ovary glabrous.
 119. Inflorescence terminal 46. *S. pyriflora*
 119. Inflorescence axillary.
 120. Bracts caducous.
 121. Nerves more than 10 pairs.
 122. Inflorescence a (basally branched) spike, forming a cone in bud. Fruits more than 20 mm long 19. *S. costata*
 122. Inflorescence not a spike. Fruits less than 20 mm long.
 123. Bracts and bracteoles glabrous 46. *S. pyriflora*
 123. Bracts and bracteoles hairy.
 124. Leaf margin entire. Disk inconspicuous 36. *S. maliliensis*
 124. Leaf margin not entire. Disk clearly present.
 125. Bracts shorter than 3 mm. Stamens less than 100. Corolla c. 4 mm 11. *S. brandisii*
 125. Bracts longer than 3 mm. Stamens more than 100. Corolla c. 5 mm long. 11b. *S. brandisii* var. *pseudoclethra*
 121. Nerves less than 10 pairs.
 126. Disk hairy.
 127. Stamens 15–40. Petiole 1–3 mm 34. *S. lancifolia*
 127. Stamens more than 40. Petiole more than 5 mm.
 128. Ovary to c. 1 mm high.
 129. Inflorescence a (basally branched) lax spike. Bracts to c. 1 mm long 25. *S. gambliana*
 129. Inflorescence not a spike. Bracts longer than 1 mm.
 130. Inflorescence a (basally branched) raceme. Stamens 40–c. 60. Calyx lobes becoming longer by tearing. Style base glabrous 14. *S. celastrifolia*
 130. Inflorescence a panicle of racemes. Stamens more than 100. Calyx lobes not becoming longer by tearing. Style base hairy 39. *S. nivea*
 128. Ovary more than 1 mm high.
 131. Petiole 3–4 mm 9. *S. borneensis*
 131. Petiole more than 5 mm.
 132. Terminal buds glabrous.
 133. Inflorescence a (basally branched) raceme. Calyx 1½ mm long. Style base glabrous. Fruits c. 10 mm long 8. *S. batakensis*
 133. Inflorescence a fascicle or very short spike. Calyx c. 2 mm long. Style base hairy. Fruits 12–16 mm long 53. *S. tricoccata*
 132. Terminal buds hairy. Inflorescence a panicle. Calyx longer than 2 mm, lobes longer than 1½ mm. Style base hairy. Fruits more than 10 mm long 21. *S. cylindracea*
 126. Disk glabrous.
 134. Fruits 2–5-celled.
 135. Inflorescence a fascicle or a very short spike. Ovary more than 1 mm high. 53. *S. tricoccata*
 135. Inflorescence a (basally branched) raceme. Ovary to c. 1 mm high.
 136. Inflorescence axis hairy. Corolla more than 4 mm long. Calyx lobes becoming longer by tearing. Stone smooth. Seeds not straight 14. *S. celastrifolia*
 136. Inflorescence axis glabrous. Corolla shorter than c. 4 mm. Calyx lobes not becoming longer by tearing. Stone with ridges or grooves. Seeds straight 27. *S. glabriramifera*
 134. Fruits 1-celled.
 137. Reticulation fine. Ovary 2–3 mm high 12. *S. buxifolia*
 137. Reticulation coarse. Ovary 1–2 mm high.
 138. Inflorescence much branched 16–3. *S. cochinchinensis* ssp. *thwaitesii*
 138. Inflorescence simple 51. *S. sumuntia*
 120. Bracts persistent.
 139. Leaves shorter than 5 cm.
 140. Inflorescence only 1-flowered. Bracts several.
 141. Bracts shorter than 3 mm. Corolla shorter than c. 4 mm. Ovary 1–2 mm high. Stamens less than 30. Stone smooth. Seed and embryo uncinately curved towards the base. 16–4. *S. cochinchinensis* ssp. *leptophylla*
 141. Bracts longer than 3 mm. Corolla more than 4 mm long. Ovary more than 2 mm high. Stamens more than 50. Stone with ridges or grooves. Seed and embryo not uncinately curved towards the base 12. *S. buxifolia*
 140. Inflorescence more-flowered. Bract 1.
 142. Petiole 0–5 mm.
 143. Corolla 5–7 mm 57. *S. whitfordii*
 143. Corolla shorter.
 144. Leaf index less than 2. Acumen shorter than 5 mm. Bracts longer than 1 mm. 16. *S. cochinchinensis*
 144. Leaf index more than 2. Acumen longer than 5 mm 34. *S. lancifolia*
 142. Petiole more than 5 mm.

145. Inflorescence a basally branched raceme. Corolla 5–7 mm long . . . 57. *S. whitfordii*
 145. Inflorescence a (basally branched) spike. Corolla shorter than c. 4 mm.
 16–4. *S. cochinchinensis* ssp. *leptophylla*
139. Leaves longer than 5 cm.
 146. Petiole 0–5 mm 34. *S. lancifolia*
 146. Petiole more than 5 mm.
 147. Inflorescence not a spike.
 148. Inflorescence not a fascicle.
 149. Reticulation fine. Ovary c. 1 mm high 18. *S. composiracemosa*
 149. Reticulation coarse. Ovary more than 1 mm high
 16–3. *S. cochinchinensis* ssp. *thwaitesii*
148. Inflorescence a fascicle.
 150. Disk glabrous.
 151. Petiole 12–17 mm. Ovary more than 1 mm high. Nerves 8–12 pairs. Fruits 10–12 mm long
 5. *S. atjehensis*
 151. Petiole 5–12 mm. Ovary c. 1 mm high. Nerves 10–16 pairs. Fruits 7–10 mm long.
 28. *S. glomerata*
150. Disk hairy.
 152. Leaves obovate, longer than 10 cm. Acumen longer than 5 mm. Inflorescence axis hairy. Calyx regularly 5-lobed. Fruits ovoid or obovoid, 1-celled. Seeds 1, not straight 16–4. *S. cochinchinensis* ssp. *leptophylla*
 152. Leaves elliptic or circular, shorter than c. 10 cm. Acumen shorter than 5 mm. Inflorescence axis glabrous. Calyx 2–4-lobed or symmetrically cleft. Fruits cylindric or ellipsoid, 2–5-celled. Seeds more than 1, straight 40. *S. obovatifolia*
147. Inflorescence a (basally branched) spike.
 153. Twigs (exceptionally) thick.
 154. Terminal buds hairy. Disk hairy 16–4. *S. cochinchinensis* ssp. *leptophylla*
 154. Terminal buds glabrous. Disk glabrous.
 155. Inflorescence axis hairy. Bracts 2–3 mm, hairy. Bracteoles hairy. Calyx 1½–2 mm long. Fruits c. 10 mm long 6. *S. barisanica*
 155. Inflorescence axis glabrous. Bracts 5–7 mm, glabrous. Bracteoles glabrous. Calyx longer than 2 mm. Fruits c. 13 mm long. 45. *S. pulvinata*
153. Twigs not (exceptionally) thick.
 156. Calyx 2–4-lobed or symmetrically cleft.
 157. Petiole 15–25 mm 54. *S. trisepala*
 157. Petiole 7–12 mm 40. *S. obovatifolia*
 156. Calyx regularly 5-lobed.
 158. Base angle to 20–30°. Leaf index 3½–5. Nerves 11–13 pairs 29. *S. goodeniacea*
 158. Base angle more than 30°. Leaf index less than 3½. Nerves at most 11 pairs.
 159. Seed and embryo uncinately curved towards the base.
 16–4. *S. cochinchinensis* ssp. *leptophylla*
 159. Seed and embryo twice curved 16–2. *S. cochinchinensis* ssp. *laurina*

KEYS TO FLOWERING MATERIAL ARRANGED BY ISLANDS AND ISLAND GROUPS

Sumatra

1. Midrib prominent on the upper surface.
 2. Twigs hairy 4. *S. anomala*
 2. Twigs glabrous 35. *S. lucida*
1. Midrib impressed in the upper surface.
 3. Corolla hairy. 41. *S. odoratissima*
 3. Corolla glabrous.
 4. Underside of leaves glabrous.
 5. Twigs hairy.
 6. Leaves distichous. Calyx 2–4-lobed or symmetrically cleft, calyx lobes becoming longer by tearing.
 33. *S. laeteviridis*
6. Leaves spirally arranged.
 7. Leaves crowded towards the end of the twigs. Twigs thick, tapering towards apex. Petiole more than 20 mm. Corolla more than 7 mm long. Apex of leaves rounded or acute 44. *S. polyandra*
 7. Leaves evenly distributed.
 8. Calyx and ovary glabrous 5. *S. atjehensis*
 8. Calyx and/or ovary hairy.
 9. Leaves longer than 10 cm. Nerves more than 10 pairs. Inflorescence a (basally branched) spike. Bracts persistent. Ovary glabrous, to c. 1 mm high, calyx lobes longer than 1½ mm. Disk glabrous, clearly present. Fruits ampulliform, 1-celled.
 16–1. *S. cochinchinensis* ssp. *cochinchinensis*

9. Leaves shorter than c. 10 cm. Nerves less than 10 pairs. Inflorescence a raceme. Bracts caducous. Ovary hairy, 1–2 mm high, calyx lobes $1/2$ – $1\frac{1}{2}$ mm long. Disk hairy, inconspicuous. Fruits ellipsoid, 3-celled 47. *S. robinsonii*
5. Twigs glabrous.
10. Nerves 4–5 pairs 42. *S. ophirensis*
10. Nerves more than 5 pairs.
11. Calyx and/or ovary hairy. 33. *S. laeteviridis*
12. Leaves distichous 33. *S. laeteviridis*
12. Leaves spirally arranged.
13. Leaves crowded towards the end of the tapering-off twigs 44. *S. polyandra*
13. Plant different 42. *S. ophirensis*
11. Calyx and ovary glabrous.
14. Inflorescence not a spike.
15. Inflorescence a fascicle. Stamens c. 50 5. *S. atjehensis*
15. Inflorescence a raceme.
16. Stamens 40–60 14. *S. celastrifolia*
16. Stamens c. 100 8. *S. batakensis*
14. Inflorescence a (basally branched) spike.
17. Twigs thick. Terminal buds large 6. *S. barisanica*
17. Twigs not thick. Terminal buds small 16–2. *S. cochinchinensis ssp. laurina*
4. Underside of leaves hairy.
18. Twigs glabrous.
19. Leaves distichous. Petiole 1–4 mm. Corolla 3–5 mm 33. *S. laeteviridis*
19. Leaves spirally arranged. Petiole more than 5 mm.
20. Inflorescence a fascicle. Bracts persistent, c. 2 mm. Calyx glabrous. Calyx lobes not becoming longer by tearing 5. *S. atjehensis*
20. Inflorescence a spike forming a cone in bud. Bracts caducous, 3–5 mm. Calyx hairy. Calyx lobes becoming longer by tearing 48. *S. rubiginosa*
18. Twigs hairy.
21. Leaves distichous.
22. Calyx usually hairy. Inflorescence a fascicle. Bracts persistent. Ovary c. 1 mm long. Calyx c. 1 mm long. Calyx lobes not becoming longer by tearing. Style base hairy 23. *S. fasciculata*
22. Calyx often glabrous. Inflorescence a raceme or panicle of racemes. Bracts caducous. Ovary 1– $1\frac{1}{2}$ mm high. Calyx 2–3 mm. Calyx lobes becoming longer by tearing. Style base glabrous 33. *S. laeteviridis*
21. Leaves spirally arranged.
23. Calyx and ovary glabrous.
24. Leaf index 2 to 3. Nerves 8–12 pairs 5. *S. atjehensis*
24. Leaf index more than 3. Nerves 6–9 pairs.
25. Nerves less than 10 pairs 15. *S. cerasifolia*
25. Nerves more than 10 pairs 15b. *S. cerasifolia var. grandifolia*
23. Calyx and/or ovary hairy.
26. Upper side of leaves hairy (pulverulent). Leaf margin and petiole beset with many closely spaced vesicular glands 3. *S. adenophylla*
26. Upper side of leaves glabrous. Leaf margin and petiole different.
27. Ovary glabrous.
28. Nerves less than 10 pairs. Bracts caducous. Ovary 1– $1\frac{1}{2}$ mm high. Calyx $2\frac{1}{2}$ –4 mm. Calyx lobes becoming longer by tearing 15. *S. cerasifolia*
28. Nerves more than 10 pairs. Bracts persistent. Ovary to c. 1 mm long. Calyx 1 to 2 mm long. Calyx lobes not becoming longer by tearing. 16–1. *S. cochinchinensis ssp. cochinchinensis*
27. Ovary hairy.
29. Leaves longer than 15 cm.
30. Nerves 10–13 pairs 15b. *S. cerasifolia var. grandifolia*
30. Nerves 12–17 pairs 48. *S. rubiginosa*
29. Leaves shorter than c. 15 cm.
31. Bracts to c. 1 mm long.
32. Leaf margin (and petiole) beset with closely spaced glands 3. *S. adenophylla*
32. Leaf margin (and petiole) often glandular but glands not closely spaced.
33. Nerves less than 10 pairs. Reticulation coarse. Inflorescence a fascicle. Bracts persistent. Ovary c. 1 mm high. Style base hairy 23. *S. fasciculata*
33. Nerves more than 10 pairs. Reticulation fine. Inflorescence a (basally branched) raceme. Bracts caducous. Ovary more than 1 mm high. Style base glabrous 47. *S. robinsonii*
31. Bracts longer than 1 mm.
34. Angle of leaf base c. 90° 50. *S. sumatrana*
34. Angle of leaf base less than 60° 47. *S. robinsonii*

Malay Peninsula

1. Midrib prominent on the upper surface.
2. Twigs hairy.
3. Leaves evenly distributed, underside glabrous 4. *S. anomala*
3. Leaves crowded towards the end of the twigs, minutely sparsely appressedly hairy beneath. 37. *S. wikstroemifolia*
2. Twigs glabrous.
4. Leaves crowded towards the end of the twigs 37. *S. wikstroemifolia*
4. Leaves evenly distributed 35. *S. lucida*
1. Midrib impressed on the upper surface.
5. Corolla hairy. 41. *S. odoratissima*
5. Corolla glabrous.
6. Twigs hairy.
7. Leaves distichous.
8. Underside of leaves glabrous 33. *S. laeteviridis*
8. Underside of leaves hairy.
9. Bracts persistent.
10. Inflorescence a true fascicle. Ovary c. 1 mm high. Calyx 1 mm long 23. *S. fasciculata*
10. Inflorescence a short, often clustered spike. Ovary 1–2 mm high. Calyx 1½–4 mm long 20. *S. crassipes*
9. Bracts caducous 33. *S. laeteviridis*
7. Leaves spirally arranged.
11. Upper side of leaves hairy.
12. Angle of leaf base more than 90°. Bracts and bracteoles caducous. Hairs on twigs more than 2 mm long 13. *S. calycodactylus*
12. Angle of leaf base less than 90°.
13. Leaf margin (and petiole) beset with closely spaced glands. Bracts to c. 1 mm long. Calyx to c. 1 mm long, calyx lobes ½–1 mm long. Disk glabrous. Style base not conical. Fruits to c. 10 mm long 3. *S. adenophylla*
13. Leaf margin (and petiole) often glandular but glands not closely spaced. Bracts longer than 1 mm. Calyx 1½–4 mm, calyx lobes longer than 1½ mm. Disk hairy. Style base conical. Fruits 13–18 mm long 20. *S. crassipes*
11. Upper side of leaves glabrous.
14. Leaves crowded towards the end of the twigs. 37. *S. wikstroemifolia*
14. Leaves evenly distributed.
15. Underside of leaves glabrous.
16. Calyx glabrous. Inflorescence a fascicle. Disk pulvinate or cylindric. Fruits cylindrical. Seeds straight 28. *S. glomerata*
16. Calyx hairy. Inflorescence a (basally branched) spike. Disk annular. Fruits ampulliform. Seeds not straight 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
15. Underside of leaves hairy (pulverulent, nearly glabrous, in *S. adenophylla*).
17. Calyx and ovary glabrous.
18. Inflorescence a spike 15. *S. cerasifolia*
18. Inflorescence a fascicle 28. *S. glomerata*
17. Calyx and/or ovary hairy.
19. Ovary glabrous.
20. Nerves less than 10 pairs. Bracts and bracteoles caducous. Ovary 1–1½ mm high, calyx longer than 2 mm, calyx lobes 1–1½ mm long, becoming longer by tearing. Fruits 22–40 mm long, 3-celled 15. *S. cerasifolia*
20. Nerves more than 10 pairs. Bracts and bracteoles persistent. Ovary to c. 1 mm high, calyx c. 2 mm long, calyx lobes longer than 1½ mm, not becoming longer by tearing. Fruits 5–7 mm long, 1-celled 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
19. Ovary hairy.
21. Ovary more than 1 mm high.
22. Leaf margin (and petiole) beset with closely spaced glands. Bracts to c. 1 mm long. Calyx to c. 1 mm long 3. *S. adenophylla*
22. Leaf margin (and petiole) often glandular but glands not closely spaced. Bracts longer than 1 mm.
23. Nerves 6–11 pairs. Reticulation faintly prominent. Bracts and bracteoles persistent. Calyx lobes not becoming longer by tearing. Fruits 13–18 mm long 20. *S. crassipes*
23. Nerves 12–17 pairs. Reticulation much prominent. Bracts and bracteoles caducous. Calyx lobes becoming longer by tearing. Fruits to c. 10 mm long 48. *S. rubiginosa*
21. Ovary to c. 1 mm high.
24. Leaves longer than 15 cm 20. *S. crassipes*
24. Leaves shorter than c. 15 cm.
25. (Reticulation fine.) Bracts and bracteoles caducous 42. *S. ophirensis*
25. (Reticulation coarse.) Bracts persistent.

26. Inflorescence an often clustered short spike. Bracts 1–4 mm. Calyx $2\frac{1}{2}$ –3 mm. Stamens more than 60. Fruits not ampulliform, 13–18 mm long 20. *S. crassipes*
26. Inflorescence a fascicle. Bracts to c. 1 mm long. Calyx c. 1 mm long. Stamens 12–35. Fruits ampulliform, 5–7 mm long 23. *S. fasciculata*
6. Twigs glabrous.
27. Nerves more than 10 pairs.
28. Underside of leaves hairy.
29. Inflorescence a spike 48. *S. rubiginosa*
29. Inflorescence a fascicle 28. *S. glomerata*
28. Underside of leaves glabrous.
30. Petiole more than 20 mm. Inflorescence a spike or a cone. Fruits 3-celled 7. *S. barringtoniifolia*
30. Petiole less than 20 mm.
31. Inflorescence terminal 46. *S. pyriflora*
31. Inflorescence axillary.
32. Calyx and/or ovary hairy. Corolla 2–5 mm 42. *S. ophirensis*
32. Calyx and ovary glabrous.
33. Intramarginal vein far from margin. Inflorescence a fascicle. Bracts persistent, hairy, shorter than 3 mm. Ovary c. 1 mm high, calyx 1–2 mm long, calyx lobes not becoming longer by tearing. Corolla 4–5 mm. Stamens less than 50. Fruits 7–10 mm long. 28. *S. glomerata*
33. Intramarginal vein close to margin. Inflorescence a raceme or panicle of racemes. Bracts caducous, glabrous, longer than 3 mm. Ovary $1\frac{1}{2}$ –2 mm high, calyx 3–5 mm, calyx lobes becoming longer by tearing. Corolla 8–10 mm long. Stamens c. 100 or more. Fruits c. 15 mm long 46. *S. pyriflora*
27. Nerves less than 10 pairs.
34. Underside of leaves hairy.
35. Leaves crowded towards the end of the twigs 37. *S. wikstroemifolia*
35. Leaves evenly distributed.
36. Bracts persistent. Disk glabrous. Fruits 13–18 mm long 20. *S. crassipes*
36. Bracts caducous. Disk hairy. Fruits 7–12 mm long 33. *S. laeteviridis*
34. Underside of leaves glabrous.
37. Calyx and/or ovary hairy.
38. Disk hairy.
39. Leaves distichous 33. *S. laeteviridis*
39. Leaves spirally arranged 42. *S. ophirensis*
38. Disk glabrous.
40. Inflorescence a short, often clustered spike. Bracts persistent. 20. *S. crassipes*
40. Inflorescence a raceme. Bracts caducous 51. *S. sumuntia*
37. Calyx and ovary glabrous.
41. Inflorescence a (basally branched) spike. Bracts persistent 16–2. *S. cochinchinensis* ssp. *laurina*
41. Inflorescence not a spike. Bracts caducous.
42. Inflorescence a panicle of racemes. Stamens more than 100 39. *S. nivea*
42. Inflorescence a (basally branched) raceme. Stamens 25–60. 14. *S. celastrifolia*
43. Calyx lobes becoming longer by tearing. 51. *S. sumuntia*
43. Calyx lobes not becoming longer by tearing

Java & The Lesser Sunda Islands

1. Corolla hairy 41. *S. odoratissima*
1. Corolla glabrous.
2. Midrib prominent on the upper surface 35. *S. lucida*
2. Midrib impressed in the upper surface.
3. Twigs hairy.
4. Leaves distichous 23. *S. fasciculata*
4. Leaves spirally arranged.
5. Underside of leaves glabrous. (If leaf margin and petiole beset with closely spaced vesicular glands: 3. *S. adenophylla*.) 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
5. Underside of leaves hairy.
6. Upper side of leaves hairy (pulverulent) 3. *S. adenophylla*
6. Upper side of leaves glabrous.
7. Ovary glabrous, calyx longer than 1 mm. Bracts longer than 1 mm 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
7. Ovary hairy.
8. Leaf index more than 3. Leaf margin (and petiole) beset with closely spaced glands. Ovary 1–2 mm high 3. *S. adenophylla*
8. Leaf index 2–3. Leaf margin (and petiole) often glandular but glands not closely spaced. Ovary c. 1 mm high 23. *S. fasciculata*

- 3. Twigs glabrous.
- 9. Calyx and/or ovary hairy.
 - 10. Ovary hairy. Inflorescence a raceme. Calyx glabrous 32. *S. junghuhnii*
 - 10. Ovary glabrous. Inflorescence a spike. Calyx hairy.
- 16-1. *S. cochinchinensis* ssp. *cochinchinensis*
- 9. Calyx and ovary glabrous.
 - 11. Inflorescence axis glabrous.
 - 12. Petiole less than 20 mm 16-2. *S. cochinchinensis* ssp. *laurina*
 - 12. Petiole more than 20 mm 16-4. *S. cochinchinensis* ssp. *leptophylla*
 - 11. Inflorescence axis hairy.
 - 13. Nerves less than 10 pairs 16. *S. cochinchinensis*
 - 13. Nerves more than 10 pairs.
 - 14. Angle of leaf base 25-40°. Inflorescence a (basally branched) spike, forming a cone in bud. 19. *S. costata*
 - 14. Angle of leaf base more than 60°. Inflorescence a raceme 11. *S. brandisii*

Borneo

- 1. Corolla hairy 41. *S. odoratissima*
- 1. Corolla glabrous.
- 2. Midrib flat or prominent on the upper surface 4. *S. anomala*
- 2. Midrib impressed in the upper surface.
- 3. Underside of leaves glabrous. (If leaf margin and petiole beset with closely spaced vesicular glands: 3. *S. adenophylla*).
- 4. Twigs hairy.
 - 5. Leaves distichous 33. *S. laeteviridis*
 - 5. Leaves spirally arranged.
 - 6. Leaves 4-6 cm. Petiole 3-4 mm 10. *S. brachybotrys*
 - 6. Leaves longer than 6 cm. Petiole more than 5 mm.
 - 7. Leaves evenly distributed. Twigs not thick, cylindrical. Leaf margin not entire. Petiole less than 20 mm. Ovary glabrous, to c. 1 mm high, calyx 1-2 mm long. Corolla 3-5 mm. Fruits ampulliform, 1-celled. Seed 1, not straight. Apex of leaves acuminate. 16-1. *S. cochinchinensis* ssp. *cochinchinensis*
 - 7. Leaves crowded towards the end of the twigs. Twigs thick, tapering towards apex. Leaf margin entire. Petiole more than 20 mm. Ovary hairy, c. 2 mm high, calyx 2-3 mm long. Corolla 8-10 mm long. Fruits ellipsoid, 3-celled. Seeds more than 1, straight. Apex of leaves rounded or acute 44. *S. polyandra*
- 4. Twigs glabrous.
- 8. Calyx and/or ovary hairy.
 - 9. Leaves distichous. Calyx glabrous 33. *S. laeteviridis*
 - 9. Leaves spirally arranged.
 - 10. Inflorescence a 1-3-flowered spike. Bracts caducous. Stamens c. 100. Petiole 3-4 mm. Leaves 4-6 cm 10. *S. brachybotrys*
 - 10. These characters not combined.
 - 11. Leaves 15-50 mm long 12. *S. buxifolia*
 - 11. Leaves longer than 5 cm.
 - 12. Petiole more than 20 mm. Twigs thick. Inflorescence a spike. Calyx 3-3½ mm 7. *S. barringtoniifolia*
 - 12. Petiole less than 20 mm. Inflorescence a raceme or a spike. Calyx to c. 1 mm long 42. *S. ophirensis*
- 8. Calyx and ovary glabrous.
- 13. Nerves more than 10 pairs 29. *S. goodeniacea*
- 13. Nerves less than 10 pairs.
- 14. Bracts persistent.
 - 15. Leaves shorter than 5 cm 12. *S. buxifolia*
 - 15. Leaves longer than 5 cm 16-2. *S. cochinchinensis* ssp. *laurina*
- 14. Bracts caducous.
- 16. Ovary to c. 1 mm high. Apex of leaf mostly abruptly acuminate.
- 17. Leaf margin entire. Inflorescence axis glabrous. Petiole 5-10 mm 25. *S. gambliana*
- 17. Leaf margin not entire. Inflorescence axis hairy. Petiole 3-15 mm 14. *S. celastriifolia*
- 16. Ovary more than 1 mm high. Leaf apex usually not or faintly acuminate.
- 18. Leaf margin entire. Calyx ¾-1 mm long. Disk hairy. Petiole 3-4 mm 9. *S. borneensis*
- 18. Leaf margin not entire. Calyx longer than 1 mm. Disk glabrous or the style base hairy.
- 19. Leaves shorter than 5 cm and acumen shorter than 5 mm. Reticulation fine. Inflorescence a few-flowered raceme. Bracts longer than 3 mm. Ovary 2-3 mm high, calyx 2-5 mm long. Style base glabrous. Fruits 1-celled 12. *S. buxifolia*
- 19. Leaves longer than 5 cm and acumen longer than 5 mm. Reticulation coarse. Inflorescence a fascicle or very short spike. Bracts c. 1½ mm. Ovary c. 2 mm high, calyx c. 2 mm long. Style base hairy. Fruits 3-celled. Stone smooth. Seeds more than 1 53. *S. tricoccata*

3. Underside of leaves hairy.
 20. Leaves distichous.
 21. Calyx symmetrically teared when older 33. *S. laeteviridis*
 21. Calyx regular.
 22. Stamens 25–35. Inflorescence a true fascicle. Petiole 2–8 mm. Leaves 5–18 cm. Ovary c. 1 mm high. Calyx c. 1 mm long 23. *S. fasciculata*
 22. Stamens more than 40. Flowers solitary or in a raceme or panicle. Leaves 2–9 cm. Calyx 1–3 mm.
 23. Nerves 7–11 pairs. Petiole 3–4 mm. Leaves 4–9 cm. Stamens more than 90. Calyx $1\frac{3}{4}$ –3 mm 17. *S. colombonensis*
 23. Nerves 3–8 pairs. Stamens 40–100, but when more than 90 petiole 1–2 mm.
 24. Petiole 2–4 mm. Leaves 2– $3\frac{1}{2}$ cm. Calyx c. 3 mm 52. *S. trichomarginalis*
 24. Petiole 1–2 mm. Leaves $2\frac{1}{2}$ –7 cm. Calyx 1–2 mm.
 25. Calyx c. 2 mm long 58. *S. zizyphoides*
 25. Calyx 1– $1\frac{1}{2}$ mm long.
 26. Ovary 1 mm high 31. *S. johniana*
 26. Ovary $1\frac{1}{2}$ –2 mm high 22. *S. deflexa*
 20. Leaves spirally arranged.
 27. Twigs glabrous.
 28. Leaves 4–6 cm 10. *S. brachybotrys*
 28. Leaves longer than 6 cm.
 29. Leaves 7–16 cm. Nerves 6–9 pairs 15. *S. cerasifolia*
 29. Leaves 15–45 cm. Nerves 12–17 pairs 48. *S. rubiginosa*
 27. Twigs hairy.
 30. Upper side of leaves hairy (pulverulent). 3. *S. adenophylla*
 30. Upper side of leaves glabrous.
 31. Calyx and ovary glabrous 15. *S. cerasifolia*
 31. Calyx and/or ovary hairy.
 32. Ovary glabrous.
 33. Nerves less than 10 pairs. Bracts caducous. Ovary 1– $1\frac{1}{2}$ mm high, calyx longer than 2 mm. Fruits ellipsoid, 22–40 mm long, 3-celled 15. *S. cerasifolia*
 33. Nerves more than 10 pairs. Bracts persistent. Ovary to c. 1 mm high, calyx 1–2 mm long. Fruits ampulliform, 5–7 mm long, 1-celled.
 - 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
 32. Ovary hairy.
 34. Leaves longer than 15 cm 48. *S. rubiginosa*
 34. Leaves shorter than c. 15 cm.
 35. Inflorescence only 1-flowered.
 36. Angle of leaf base more than 90° 31. *S. johniana*
 36. Angle of leaf base less than 90°.
 37. Bracts 1. Calyx 1–2 mm long 20. *S. crassipes*
 37. Bracts several. Calyx c. 3 mm 10. *S. brachybotrys*
 35. Inflorescence more-flowered.
 38. Bracts caducous. Petiole 3–4 mm. Nerves 6–9. Stamens c. 100 10. *S. brachybotrys*
 38. Bracts persistent. Petiole 2–12 mm. Nerves 3–12. Stamens 12–more than 100.
 39. Calyx to c. 1 mm long. Stamens 12–50.
 40. Leaf index more than 3. Leaf margin (and petiole) beset with closely spaced glands. Ovary 1–2 mm high 3. *S. adenophylla*
 40. Leaf index 2–3. Leaf margin (and petiole) often glandular but glands not closely spaced. Ovary c. 1 mm high 23. *S. fasciculata*
 39. Calyx longer than 1 mm. Stamens 25–100. 20. *S. crassipes*

Philippines

1. Leaves verticillate 55. *S. verticillifolia*
1. Leaves not verticillate.
 2. Midrib prominent in the upper surface.
 3. Twigs glabrous. Petiole more than 5 mm 35. *S. lucida*
 3. Twigs hairy. Petiole 1–5 mm 34. *S. lancifolia*
 2. Midrib impressed on the upper surface.
 4. Corolla hairy (in the Philippines sometimes nearly glabrous!) 41. *S. odoratissima*
 4. Corolla glabrous.
 5. Twigs hairy.
 6. Leaves distichous 23. *S. fasciculata*
 6. Leaves spirally arranged.
 7. Calyx divided into three $2\frac{1}{2}$ mm long lobes 54. *S. trisepala*
 7. Calyx not so.
 8. Leaves crowded towards the end of the twigs. Twigs thick, tapering towards the apex. Fruits 3-celled. Apex of leaves rounded or acute 44. *S. polyandra*

8. Leaves evenly distributed.
9. Underside of leaves glabrous. (If leaf margin and petiole beset with closely spaced vesicular glands: 3. *S. adenophylla*).
10. Ovary hairy, c. 1½ mm high. Inflorescence a lax raceme. Bracts to c. 1 mm long. Calyx lobes c. ½ mm long. Stamens c. 25 24. *S. filipes*
10. Ovary glabrous (hidden between bracts!). Inflorescence a spike.
 - 16-1. *S. cochinchinensis* ssp. *cochinchinensis*
9. Underside of leaves hairy.
 11. Upper side of leaves hairy (pulverulent) 3. *S. adenophylla*
 11. Upper side of leaves glabrous.
 12. Ovary glabrous.
 13. Leaves longer than 10 cm. Petiole more than 5 mm. Nerves more than 10 pairs. Calyx lobes longer than 1½ mm. Stamens more than 30. Disk glabrous. Style base glabrous. Fruits ampulliform 16-1. *S. cochinchinensis* ssp. *cochinchinensis*
 13. Leaves shorter than c. 10 cm. Petiole 1-5 mm. Nerves 4-11 pairs. Calyx lobes ½-1½ mm long. Stamens 15-40. Disk hairy. Style base hairy. Fruits not ampulliform 34. *S. lancifolia*
 12. Ovary hairy.
 14. Leaf margin (and petiole) beset with closely spaced glands 3. *S. adenophylla*
 14. Leaf margin (and petiole) often glandular but glands not closely spaced.
 15. Style base glabrous.
 16. Bracts to c. 1 mm long. Calyx lobes c. ½ mm long, not triangular 24. *S. filipes*
 16. Bracts 2-3 mm. Calyx lobes 1-1½ mm, triangular 56. *S. vidalii*
 15. Style base hairy.
 17. Intramarginal vein present. Inflorescence a fascicle. Fruits ampulliform 23. *S. fasciculata*
 17. Intramarginal vein absent. Inflorescence a (basally branched) spike. Fruits ellipsoid to orbicular 34. *S. lancifolia*
 5. Twigs glabrous.
 18. Calyx and ovary glabrous.
 19. Inflorescence a (basally branched) spike.
 20. Acumen longer than 5 mm 34. *S. lancifolia*
 20. Acumen shorter than 5 mm.
 21. Angle of leaf base less than 60°. Bracts 2-3 mm. Calyx lobes c. 2 mm long. Style base hairy. 40. *S. obovatifolia*
 21. Angle of leaf base c. 90°. Bracts 3-5 mm. Calyx lobes longer than 2½ mm. Disk glabrous. 54. *S. trispala*
 19. Inflorescence not a spike.
 22. Bracts and bracteoles persistent.
 23. Leaves 2-5¾ cm. Inflorescence a (basally branched) raceme. Bracts longer than 3 mm. Calyx regularly 5-lobed, calyx lobes semi-ovate. Fruits ovoid, 5-7 mm long, 1-celled. 57. *S. whitfordii*
 23. Leaves 7½-11 cm. Inflorescence a fascicle. Bracts 2-3 mm long. Calyx 3-lobed, the lobes semi-elliptic. Fruits ellipsoid, 11 mm long, 3-celled 40. *S. obovatifolia*
 22. Bracts and bracteoles caducous.
 24. Inflorescence axis glabrous. Corolla 3-4 mm. Calyx lobes not becoming longer by tearing. 27. *S. glabriramifera*
 24. Inflorescence axis hairy. Corolla 4-6 mm 14. *S. celastrifolia*
 18. Calyx and/or ovary hairy.
 25. Inflorescence a spike. Ovary glabrous.
 26. Ovary ½-1 mm high 16-1. *S. cochinchinensis* ssp. *cochinchinensis*
 26. Ovary 2½ mm high 42. *S. ophirensis*
 25. Inflorescence a (sometimes compound) raceme. Ovary hairy.
 27. Inflorescence a very lax raceme of 4-10 cm. Pedicels slender, 2-15 mm. Axis of raceme sparsely pulverulent-puberulous. Stamens c. 25 24. *S. filipes*
 27. These characters not combined 42. *S. ophirensis*

Celebes & The Moluccas

1. Corolla hairy 41. *S. odoratissima*
1. Corolla glabrous.
 2. Midrib prominent on the upper surface 35. *S. lucida*
 2. Midrib impressed in the upper surface.
 3. Twigs hairy.
 4. Underside of leaves glabrous. (If leaf margin and petiole beset with closely spaced vesicular glands: 3. *S. adenophylla*).
 5. Leaves distichous. Bracts caducous 33. *S. laeteviridis*
 5. Leaves spirally arranged.

- 6. Calyx and ovary glabrous 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 6. Calyx and/or ovary hairy.
- 7. Leaves crowded towards the end of the twigs. Twigs thick, tapering towards apex. 44. *S. polyandra*
- 7. Leaves evenly distributed.
- 8. Ovary hairy 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 8. Ovary glabrous.
- 9. Ovary to c. 1 mm high 16-1. *S. cochinchinensis* ssp. *cochinchinensis*
- 9. Ovary more than 1 mm high 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 4. Underside of leaves hairy.
- 10. Leaves distichous.
- 11. Inflorescence a fascicle. Bracts persistent. Ovary c. 1 mm high, calyx c. 1 mm long, calyx lobes not becoming longer by tearing. Style base hairy. Fruits ampulliform 23. *S. fasciculata*
- 11. Inflorescence not a fascicle. Bracts caducous. Ovary 1-1½ mm high, calyx 2-3 mm, calyx lobes becoming longer by tearing. Style base glabrous. Fruits not ampulliform 33. *S. laeteviridis*
- 10. Leaves spirally arranged.
- 12. Calyx and ovary glabrous 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 12. Calyx and/or ovary hairy.
- 13. Upper side of leaves hairy 3. *S. adenophylla*
- 13. Upper side of leaves glabrous.
- 14. Ovary glabrous 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 14. Ovary hairy.
- 15. Calyx glabrous 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 15. Calyx hairy.
- 16. Bracts to c. 1 mm long.
- 17. Leaf index more than 3. Leaf margin (and petiole) beset with closely spaced glands. Ovary 1-2 mm high. Stone not ampulliform 3. *S. adenophylla*
- 17. Leaf index 2-3. Leaf margin (and petiole) often glandular but glands not closely spaced. Ovary c. 2 mm high. Stone ampulliform 23. *S. fasciculata*
- 16. Bracts longer than 1 mm.
- 18. Bracts caducous. Ovary c. 1 mm high 42-1b. *S. ophirensis* var. *densireticulata*
- 18. Bracts persistent. Ovary more than 1 mm high 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 3. Twigs glabrous.
- 19. Underside of leaves hairy.
- 20. Leaves distichous. Petiole 0-5 mm. Bracts and bracteoles caducous 33. *S. laeteviridis*
- 20. Leaves spirally arranged 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 19. Underside of leaves glabrous.
- 21. Calyx and ovary glabrous.
- 22. Ovary to c. 1 mm high.
- 23. Inflorescence a raceme. Bracts caducous 14. *S. celastriifolia*
- 23. Inflorescence a (basally branched) spike. Bracts persistent 16-2. *S. cochinchinensis* ssp. *laurina*
- 22. Ovary more than 1 mm high.
- 24. Twigs thick 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 24. Twigs not thick.
- 25. Inflorescence a raceme. Bracts caducous 36. *S. maliliensis*
- 25. Inflorescence a (basally branched) spike. Bracts persistent.
- 26. Disk hairy 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 26. Disk glabrous 16-2. *S. cochinchinensis* ssp. *laurina*
- 21. Calyx and/or ovary hairy.
- 27. Leaves distichous 33. *S. laeteviridis*
- 27. Leaves spirally arranged.
- 28. Ovary glabrous.
- 29. Ovary to c. 1 mm high 16-1. *S. cochinchinensis* ssp. *cochinchinensis*
- 29. Ovary more than 1 mm. high 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 28. Ovary hairy.
- 30. Calyx glabrous 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 30. Calyx hairy.
- 31. Bracts to c. 1 mm long 42. *S. ophirensis*
- 31. Bracts longer than 1 mm. 16-4. *S. cochinchinensis* ssp. *leptophylla*

New Guinea
(incl. New Ireland & New Britain)

- 1. Leaves (pseudo-)verticillate 30. *S. herzogii*
- 1. Leaves not verticillate.
- 2. Inflorescence only 1-flowered.
- 3. Calyx and ovary glabrous 16-4. *S. cochinchinensis* ssp. *leptophylla*

3. Calyx and/or ovary hairy.
4. Ovary hairy 49. *S. salicioides*
4. Ovary glabrous 38. *S. multibracteata*
2. Inflorescence more-flowered.
5. Calyx and ovary glabrous.
6. Twigs hairy.
7. Petiole 0 to 5 mm 16-4. *S. cochinchinensis* ssp. *leptophylla*
7. Petiole more than 5 mm.
8. Underside of leaves glabrous 16-4. *S. cochinchinensis* ssp. *leptophylla*
8. Underside of leaves hairy.
9. Upper side of leaves hairy. Ovary c. $\frac{3}{4}$ mm long. 43. *S. paucistaminea*
9. Upper side of leaves glabrous. Ovary more than 1 mm high.
10. Bracts caducous. Calyx lobes becoming longer by tearing 15. *S. cerasifolia*
10. Bracts persistent. Calyx lobes not becoming longer by tearing. 16-4. *S. cochinchinensis* ssp. *leptophylla*
6. Twigs glabrous.
11. Underside of leaves hairy 16-4. *S. cochinchinensis* ssp. *leptophylla*
11. Underside of leaves glabrous.
12. Bracts caducous.
13. Bracts longer than 3 mm 16-4. *S. cochinchinensis* ssp. *leptophylla*
13. Bracts shorter than c. 3 mm.
14. Ovary c. 1 mm long. Inflorescence a (basally branched) raceme 14. *S. celastrifolia*
14. Ovary more than 1 mm high. Inflorescence different.
15. Disk hairy. Ovary 1-1 $\frac{1}{2}$ mm. Inflorescence a panicle 21. *S. cylindracea*
15. Disk glabrous. Inflorescence an often branched spike. 16-3. *S. cochinchinensis* ssp. *thwaitesii*
12. Bracts persistent.
16. Inflorescence not a spike.
17. Inflorescence a fascicle 16-4. *S. cochinchinensis* ssp. *leptophylla*
17. Inflorescence a panicle 18. *S. composiracemosa*
16. Inflorescence a (basally branched) spike.
18. Twigs not thick.
19. Leaves 6-12 cm. Petiole 5-25 mm. Inflorescence an (often branched) spike. Flowers bisexual, ovary 1-1 $\frac{1}{2}$ mm, calyx $\frac{1}{4}$ - $\frac{3}{4}$ mm 16-3. *S. cochinchinensis* ssp. *thwaitesii*
19. Plants different. Flowers usually functional unisexual. 16-4. *S. cochinchinensis* ssp. *leptophylla*
18. Twigs thick.
20. Terminal buds hairy, small. Acumen longer than 5 mm. Bracts hairy, shorter than 3 mm. Disk hairy. Leaves elliptic or circular 16-4. *S. cochinchinensis* ssp. *leptophylla*
20. Terminal buds glabrous, large. Acumen shorter than 5 mm. Bracts glabrous, 5-7 mm. Disk glabrous. Leaves obovate 45. *S. pulvinata*
5. Calyx and/or ovary hairy.
21. Ovary glabrous.
22. Ovary hidden by bracts and bracteoles 16-1. *S. cochinchinensis* ssp. *cochinchinensis*
22. Ovary not hidden by bracts and bracteoles.
23. Inflorescence a spike, forming a short cone in bud 15. *S. cerasifolia*
23. Inflorescence sometimes a spike, but never forming a cone in bud. 16-4. *S. cochinchinensis* ssp. *leptophylla*
21. Ovary hairy.
24. Twigs at least 8 mm thick. Leaves 21-62 cm 26. *S. gigantifolia*
24. Twigs thinner. Leaves at most 33 cm, but usually much smaller.
25. Calyx 2- to 4-lobed or symmetrically cleft. Calyx lobes becoming longer by tearing. 16-4. *S. cochinchinensis* ssp. *leptophylla*
25. Calyx regularly 5-lobed.
26. Disk glabrous 16-4. *S. cochinchinensis* ssp. *leptophylla*
26. Disk hairy.
27. Bracts and bracteoles caducous 21. *S. cylindracea*
27. Bracts persistent 16-4. *S. cochinchinensis* ssp. *leptophylla*

KEYS TO FRUITING MATERIAL ARRANGED BY ISLANDS AND ISLAND GROUPS

Sumatra

1. Midrib prominent on the upper surface.
2. Twigs hairy. Terminal buds hairy, small. Seeds straight 4. *S. anomala*
2. Twigs glabrous. Terminal buds glabrous. Seeds curved 35. *S. lucida*
1. Midrib impressed on the upper surface.
3. Underside of leaves glabrous.

4. Twigs hairy.
5. Leaves distichous 33. *S. laeteviridis*
5. Leaves spirally arranged.
6. Leaves crowded towards the end of the twigs. Twigs thick, tapering towards apex. Petiole more than 20 mm. Apex of leaves rounded or acute 44. *S. polyandra*
6. Leaves evenly distributed.
7. Fruits ampulliform. Inflorescence a (basally branched) spike. Seeds not straight.
16-1. *S. cochinchinensis* ssp. *cochinchinensis*
7. Fruits ellipsoid.
8. Fruits 10-12 mm long. Inflorescence a fascicle. Bracts persistent 5. *S. atjehensis*
8. Fruits 7-10 mm long. Inflorescence a (basally branched) raceme. Bracts caducous
47. *S. robinsonii*
4. Twigs glabrous.
9. Nerves less than 5 pairs 42. *S. ophirensis*
9. Nerves more than 5 pairs.
10. Leaves distichous 33. *S. laeteviridis*
10. Leaves spirally arranged.
11. Inflorescence a (basally branched) spike.
12. Fruits ovoid to orbicular, 9-10 mm long. Twigs thick. Terminal buds large 6. *S. barisanica*
12. Fruits ampulliform to globose, 5-7 mm long 16-2. *S. cochinchinensis* ssp. *laurina*
11. Inflorescence not a spike (rarely a cone in bud).
13. Bracts persistent.
14. Petiole 12-17 mm. Fruits ellipsoid. Inflorescence a fascicle 5. *S. atjehensis*
14. Petiole 3-9 mm. Fruits ampulliform. Inflorescence a raceme or panicle 42. *S. ophirensis*
13. Bracts caducous.
15. Fruits 1-celled. Inflorescence a rusty tomentellous panicle 41. *S. odoratissima*
15. Fruits 2-3-celled. Inflorescence a raceme.
16. Leaf margin entire. Fruits c. 10 mm. Seeds straight 8. *S. batakensis*
16. Leaf margin not entire. Fruits 4-10 mm, the sterile cells larger than the fertile ones, towards the base filled with air 14. *S. celastrifolia*
3. Underside of leaves hairy.
17. Twigs glabrous.
18. Leaves distichous. Petiole 1-4 mm 33. *S. laeteviridis*
18. Leaves spirally arranged. Petiole more than 10 mm.
19. Inflorescence a rusty tomentellous panicle 41. *S. odoratissima*
19. Inflorescence a spike or fascicle.
20. Leaves 8-21 cm. Reticulation faintly prominent. Inflorescence a fascicle. Bracts persistent. Fruits 10-12 mm long. Seeds straight. Stone different from the following 5. *S. atjehensis*
20. Leaves 15-45 cm. Reticulation much prominent. Inflorescence a (basally branched) spike (a cone in bud). Bracts caducous. Fruits 8-10 mm long. Seeds not straight. Stone with a transverse constriction at one side 48. *S. rubiginosa*
17. Twigs hairy.
21. Leaves distichous.
22. Fruits ampulliform. Inflorescence a fascicle. Bracts persistent. Stone ampulliform.
23. *S. fasciculata*
22. Fruits not ampulliform. Inflorescence not a fascicle. Bracts caducous. Stone not ampulliform.
33. *S. laeteviridis*
21. Leaves spirally arranged.
23. Upper side of leaves hairy 3. *S. adenophylla*
23. Upper side of leaves glabrous.
24. Bracts persistent.
25. Fruits 10-12 mm long and 5-6 mm broad 5. *S. atjehensis*
25. Fruits to c. 10 mm long.
26. Stone ellipsoid. Leaf margin (and petiole) beset with closely spaced glands.
3. *S. adenophylla*
26. Stone ampulliform. Fruits 5-7 mm.
27. Nerves more than 10 pairs. Inflorescence a (basally branched) spike.
16-1. *S. cochinchinensis* ssp. *cochinchinensis*
27. Nerves less than 10 pairs. Inflorescence a fascicle. 23. *S. fasciculata*
24. Bracts caducous.
28. Inflorescence not a spike.
29. Inflorescence a panicle. Seeds not straight 41. *S. odoratissima*
29. Inflorescence a (basally branched) raceme.
30. Angle of leaf base c. 90° 50. *S. sumatrana*
30. Angle of leaf base 20-60° 47. *S. robinsonii*
28. Inflorescence a (basally branched) spike or a cone.
31. Fruits to c. 10 mm long; mesocarp fleshy (shrivelled when dry) or thin, coriaceous.
32. Leaves longer than 15 cm. Fruits 1-celled. Angle of leaf base 20-40°. Stone with low ridges and a depression or transverse groove near the base. Seeds not straight. 48. *S. rubiginosa*

32. Leaves 6–14 cm. Fruits 3-celled. Angle of leaf base c. 90°. Stone with low not interrupted ridges or grooves or brain-like grooved. Seeds straight. 50. *S. sumatrana*
 31. Fruits 22–40 mm long; mesocarp woody or corky.
 33. Nerves 10–13 pairs. 15b. *S. cerasifolia* var. *grandifolia*
 33. Nerves 6–9 pairs 15. *S. cerasifolia*

Malay Peninsula

1. Midrib prominent on the upper surface.
 2. Twigs hairy.
 3. Leaves evenly distributed. Fruits ellipsoid 4. *S. anomala*
 3. Leaves crowded towards the end of the twigs. Fruits ovoid 37. *S. wikstroemifolia*
 2. Twigs glabrous.
 4. Leaves crowded towards the end of the twigs. Fruits ovoid 37. *S. wikstroemifolia*
 4. Leaves evenly distributed. Fruits ellipsoid 35. *S. lucida*
 1. Midrib impressed on the upper surface.
 5. Twigs hairy.
 6. Leaves distichous.
 7. Inflorescence a raceme or panicle. Fruits ovoid to ellipsoid, 7–12 mm. Bracts caducous.
 33. *S. laeteviridis*
 7. Inflorescence a fascicle. Fruits ampulliform. Bracts persistent 23. *S. fasciculata*
 6. Leaves spirally arranged.
 8. Upper side of leaves hairy.
 9. Angle of leaf base more than 90°. Bracts caducous. Hairs on twigs more than 2 mm long.
 13. *S. calycodactylos*
 9. Angle of leaf base less than 90°.
 10. Fruits 8–10 mm long. Leaf margin (and petiole) beset with closely spaced glands.
 3. *S. adenophylla*
 10. Fruits more than 10 mm long. Leaf margin (and petiole) often glandular but glands not closely spaced 20. *S. crassipes*
 8. Upper side of leaves glabrous.
 11. Leaves crowded towards the end of the twigs. Inflorescence a spike. Fruits ovoid, 10–12 mm.
 37. *S. wikstroemifolia*
 11. Leaves evenly distributed.
 12. Underside of leaves glabrous. (If leaf margin and petiole beset with closely spaced vesicular glands: 3. *S. adenophylla*.)
 13. Fruits cylindrical. Inflorescence a fascicle 28. *S. glomerata*
 13. Fruits ampulliform or ovoid. Inflorescence a spike or a panicle.
 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
 14. Fruits ampulliform. Inflorescence a (basically branched) spike. Seeds not straight.
 41. *S. odoratissima*
 14. Fruits ± ovoid. Inflorescence a panicle. Seeds curved 41. *S. odoratissima*
 12. Underside of leaves hairy (or pulverulent, nearly glabrous, in *S. adenophylla*).
 15. Bracts caducous.
 16. Stone smooth. Fruit 5–8 mm, ellipsoid 42–1b. *S. ophirensis* var. *densireticulata*
 16. Stone with ridges or grooves.
 17. Fruits 3-celled with 8 high ridges, 22–40 mm 15. *S. cerasifolia*
 17. Fruits 1-celled.
 18. Inflorescence a panicle 41. *S. odoratissima*
 18. Inflorescence a (basally branched) spike (a cone in bud). 48. *S. rubiginosa*
 15. Bracts persistent.
 19. Fruits more than 13–18 mm long 20. *S. crassipes*
 19. Fruits to c. 10 mm long.
 20. Stone ellipsoid. Leaf margin (and petiole) beset with closely spaced glands 3. *S. adenophylla*
 20. Stone ampulliform.
 21. Nerves more than 10 pairs. Inflorescence a (basally branched) spike. Seeds not straight.
 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
 21. Nerves 6–8 pairs. Inflorescence a fascicle 23. *S. fasciculata*
 5. Twigs glabrous.
 22. Underside of leaves hairy.
 23. Leaves crowded towards the end of the twigs. Nerves 8–10 pairs. Stone smooth. Inflorescence a spike 37. *S. wikstroemifolia*
 23. Leaves evenly distributed or nerves more than 10 pairs. Stone with ridges or grooves.
 24. Leaves distichous. Inflorescence a raceme or panicle 33. *S. laeteviridis*
 24. Leaves spirally arranged.
 25. Nerves less than 10 pairs. Bracts persistent. Fruits 13–18 mm long. Stone with low not interrupted ridges or grooves or brain-like grooved. Seeds straight 20. *S. crassipes*
 25. Nerves 12–17 pairs. Bracts caducous. Fruits 8–10 mm long. Stone with low ridges and a depression or transverse groove near the base. Seeds not straight 48. *S. rubiginosa*

22. Underside of leaves glabrous. 33. *S. laeteviridis*
 26. Leaves distichous
 26. Leaves spirally arranged. 46. *S. pyriflora*
 27. Inflorescence terminal
 27. Inflorescence axillary.
 28. Bracts caducous. 7. *S. barringtoniifolia*
 29. Inflorescence a spike. Fruits 25–40 mm.
 29. Inflorescence not a spike. Fruits shorter than 25 mm.
 30. Inflorescence a panicle. 39. *S. nivea*
 31. Petiole 7–10 mm 46. *S. pyriflora*
 31. Petiole 10–50 mm 41. *S. odoratissima*
 30. Inflorescence a (basally branched) raceme (rarely a cone in bud). 14. *S. celastrifolia*
 32. Fruits 3-celled
 32. Fruits 1-celled.
 33. Nerves 5–8 pairs. Terminal buds hairy 42. *S. ophirensis*
 33. Nerves 9–14 pairs. Terminal buds glabrous 51. *S. sumuntia*
 46. *S. pyriflora*
 28. Bracts persistent.
 34. Fruits ovoid to cylindrical.
 35. Acumen shorter than 5 mm. Apex of leaves rounded or acute 42. *S. ophirensis*
 35. Acumen longer than 5 mm.
 36. Nerves 10–16 pairs. Reticulation coarse. Inflorescence a fascicle. Fruits 7–10 mm long. 28. *S. glomerata*
 36. Nerves 3–11 pairs. Reticulation fine. Inflorescence a (basally branched) spike. Fruits 13–18 mm long 20. *S. crassipes*
 34. Fruits ampulliform.
 37. Petiole 2–9 mm. Inflorescence a raceme or panicle 42. *S. ophirensis*
 37. Petiole 10–15 mm. Inflorescence a spike 16–2. *S. cochinchinensis ssp. laurina*

Java & The Lesser Sunda Islands

1. Midrib prominent on the upper surface 35. *S. lucida*
 1. Midrib impressed in the upper surface.
 2. Twigs hairy.
 3. Leaves distichous 23. *S. fasciculata*
 3. Leaves spirally arranged.
 4. Underside of leaves glabrous. 41. *S. odoratissima*
 5. Fruits 8–25 mm
 5. Fruits 5–7 mm 16–1. *S. cochinchinensis ssp. cochinchinensis*
 4. Underside of leaves hairy.
 6. Upper side of leaves hairy (pulverulent) 3. *S. adenophylla*
 6. Upper side of leaves glabrous.
 7. Seeds not straight. Embryo at least U-shaped curved. 16–1. *S. cochinchinensis ssp. cochinchinensis*
 8. Fruits ampulliform. Inflorescence a (basally branched) spike. Bracts persistent. Seeds twice curved
 8. Fruits not ampulliform. Inflorescence a panicle. Bracts caducous. Seeds U-shaped 41. *S. odoratissima*
 7. Seeds straight. Embryo at most slightly curved.
 9. Leaf index more than 3. Leaf margin (and petiole) beset with closely spaced glands. Stone not ampulliform 3. *S. adenophylla*
 9. Leaf index 2–3. Leaf margin (and petiole) often glandular but glands not closely spaced. Stone ampulliform 23. *S. fasciculata*
 2. Twigs glabrous.
 10. Fruits ampulliform 16. *S. cochinchinensis*
 10. Fruits spindle-shaped or otherwise not ampulliform.
 11. Inflorescence a (basally branched) spike or a cone.
 12. Angle of leaf base less than 60°. Fruits 20–40 mm long 19. *S. costata*
 12. Angle of leaf base more than 60°. Fruits to c. 10 mm long. 16–4. *S. cochinchinensis ssp. leptophylla*
 11. Inflorescence not a spike (rarely a cone in bud).
 13. Terminal buds large (7–10 mm) 32. *S. junghuhnii*
 13. Terminal buds small.
 14. Inflorescence a panicle. Embryo curved 41. *S. odoratissima*
 14. Inflorescence a (basally branched) raceme. Embryo straight 11. *S. brandisii*

Borneo

1. Midrib flat or prominent on the upper surface 4. *S. anomala*
1. Midrib impressed in the upper surface.
2. Twigs glabrous.
3. Underside of leaves hairy.
4. Leaves distichous. Seeds straight 33. *S. laeteviridis*
4. Leaves spirally arranged.
5. Leaves 4–6 cm. Nerves 6–9 pairs. Petiole 3–4 mm 10. *S. brachybotrys*
5. Leaves 7–45 cm. Nerves 5–17 pairs. Petiole 10–50 mm.
6. Leaves 15–45 cm. Nerves 12–17 pairs. Inflorescence a spike 48. *S. rubiginosa*
6. Leaves 7–40 cm. Nerves 5–16 pairs. Inflorescence a panicle 41. *S. odoratissima*
3. Underside of leaves glabrous.
7. Leaves distichous 33. *S. laeteviridis*
7. Leaves spirally arranged.
8. Bracts persistent.
9. Leaves shorter than 5 cm 12. *S. buxifolia*
9. Leaves longer than 5 cm.
10. Inflorescence not a spike 42. *S. ophirensis*
10. Inflorescence a (basally branched) spike or a cone.
11. Petiole 3–10 mm. Leaves 6–22 mm. Nerves 6–13 pairs 42. *S. ophirensis*
11. Petiole 10–25 mm.
12. Petiole 10–15 mm. Leaves 4½–21 cm. Nerves 6–9 pairs. 16–2. *S. cochinchinensis* ssp. *laurina*
12. Petiole 15–25 mm. Leaves 17–30 cm. Nerves 11–13 pairs 29. *S. goodeniacea*
8. Bracts caducous.
13. Inflorescence a (basally branched) spike or a cone in bud.
14. Petiole 3–4 mm 10. *S. brachybotrys*
14. Petiole more than 5 mm. (When dubious under "15", look under 53. *S. tricoccata*.)
15. Leaves longer than 15 cm. Nerves more than 10 pairs. Twigs thick. Terminal buds hairy. Petiole more than 20 mm. Fruits 25–40 mm 7. *S. barringtoniifolia*
15. Leaves shorter than c. 10 cm. Nerves less than 10 pairs. Twigs not thick. Terminal buds glabrous. Petiole 5–10 mm 25. *S. gambliana*
13. Inflorescence not a spike (rarely a cone in bud).
16. Inflorescence a short spike, fascicle or panicle.
17. Fruits 1-celled. Inflorescence a panicle. Stone with ridges or grooves. Seed 1, not straight. 41. *S. odoratissima*
17. Fruits 3-celled. Inflorescence a fascicle. Stone smooth. Seeds more than 1, straight. 53. *S. tricoccata*
16. Inflorescence a (basally branched) raceme.
18. Leaves 1½–5 cm. Nerves 6–9 pairs. Fruits ellipsoid, 10–15 mm long 12. *S. buxifolia*
18. Leaves longer than 5 cm.
19. Apex of leaf rounded to faintly acuminate.
20. Leaves 5–8 cm. Nerves 6–9 pairs. Petiole 3–4 mm. Fruit unknown 9. *S. borneensis*
20. Leaves 6–18 cm. Nerves 6–13 pairs. Petiole 3–10 mm. Fruit ovoid to ellipsoid, 5–12 mm. 42. *S. ophirensis*
19. Apex of leaf rather abruptly acuminate.
21. Fruit globose, 3-celled, the sterile cells filled with air 14. *S. celastrifolia*
21. Fruit ovoid to ellipsoid, 1-celled 42. *S. ophirensis*
2. Twigs hairy.
22. Leaves distichous.
23. Underside of leaves glabrous 33. *S. laeteviridis*
23. Underside of leaves hairy.
24. Leaf base 90–130°. Flowers solitary. Petiole 1–3 mm. Leaves ovate 2½–7 cm. Nerves 3–6 pairs. Fruit narrowly flask-shaped, c. 13 mm long 31. *S. johniana*
24. These characters not combined. Fruits ellipsoid to ovoid.
25. Petiole 3–4 mm. Leaves 4–12 cm. Nerves 7–11 pairs. Base of leaves 40–90°. Inflorescence more flowered. Bracts caducous.
26. Leaves 4–9 cm, acumen 9–16 mm, base 40–90° 17. *S. colombonensis*
26. Leaves 9–12 cm, acumen 7–12 mm, base c. 90° 33. *S. laeteviridis*
25. Petiole ½–3 mm, if up to 4 mm, inflorescence 1-flowered. Nerves 4–9 pairs.
27. Acumen 1–3 mm. Inflorescence 1-flowered. Leaves 2–3½ cm. Bracts persistent. 52. *S. trichomarginalis*
27. These characters not combined.
28. Angle of leaf base 50–90°. Flowers solitary or in a few-flowered raceme. Bracts persistent. Petiole 1–2 mm. Leaves 2½–5½ cm. Nerves 5–9 pairs. Acumen c. 5 mm. 58. *S. zizyphoides*
28. These characters not combined 33. *S. laeteviridis*
22. Leaves spirally arranged.

29. Leaves crowded towards the end of the twigs. Twigs thick, with large leaf-scars. **44. *S. polyandra***
29. Leaves evenly distributed.
30. Underside of leaves glabrous. (If leaf margin and petiole beset with closely spaced vesicular glands: 3. *S. adenophylla*.)
31. Inflorescence a spike.
32. Leaves 4–6 cm. Petiole 3–4 mm **10. *S. brachybotrys***
32. Leaves 6–25 cm. Petiole more than 5 mm. Nerves more than 10 pairs. Fruits ampulliform. Stone ampulliform **16–1. *S. cochinchinensis* ssp. *cochinchinensis***
31. Inflorescence a panicle **41. *S. odoratissima***
30. Underside of leaves hairy.
33. Upper side of leaves hairy (pulverulent) **3. *S. adenophylla***
33. Upper side of leaves glabrous.
34. Seeds not straight.
35. Petiole 3–4 mm **10. *S. brachybotrys***
35. Petiole more than 5 mm.
36. Fruits ampulliform. Bracts persistent **16–1. *S. cochinchinensis* ssp. *cochinchinensis***
36. Fruits not ampulliform.
37. Inflorescence a panicle **41. *S. odoratissima***
37. Inflorescence a (basally branched) spike (a cone in bud). **48. *S. rubiginosa***
34. Seeds straight.
38. Fruits to c. 10 mm long.
39. Leaf index more than 3. Leaf margin (and petiole) beset with closely spaced glands. Stone ellipsoid **3. *S. adenophylla***
39. Leaf index 2–3. Leaf margin (and petiole) often glandular but glands not closely spaced. Stone ampulliform **23. *S. fasciculata***
38. Fruits more than 10 mm long.
40. Angle of leaf base more than 60°.
41. Angle of leaf base less than 90°. Twigs and underside of leaves (appressedly) pubescent, puberulous or pilose. Fruits not ampulliform, 2–3-celled. Stone with ridges or grooves. **20. *S. crassipes***
41. Angle of leaf base more than 90°. Twigs and underside of leaves not appressedly pubescent or puberulous. Fruits ampulliform, 1-celled. Stone smooth **31. *S. johniana***
40. Angle of leaf base less than 60°.
42. Petiole 1–10 mm. Fruits 13–18 mm long **20. *S. crassipes***
42. Petiole 15–25 mm. Fruits 22–40 mm long **15. *S. cerasifolia***

Philippines

1. Leaves verticillate **55. *S. verticillifolia***
1. Leaves not verticillate.
2. Midrib prominent on the upper surface.
3. Twigs glabrous. Petiole more than 5 mm **35. *S. lucida***
3. Twigs hairy. Petiole 1–5 mm **34. *S. lancifolia***
2. Midrib impressed in the upper surface.
4. Twigs hairy.
5. Underside of leaves glabrous. (If leaf margin and petiole beset with closely spaced vesicular glands: 3. *S. adenophylla*.)
6. Fruits spindle-shaped or otherwise not ampulliform.
7. Leaves evenly distributed, 4¹/₂–7¹/₂ cm. Acumen 12–20 mm. Twigs not thick, cylindrical. Nerves 5–6 pairs. Petiole 7–8 mm. Fruits 1-celled. Seed 1. Apex of leaves acuminate **24. *S. filipes***
7. Leaves crowded towards the end of the twigs, longer than 10 cm. Acumen shorter than 5 mm. Twigs thick, tapering towards apex. Nerves more than 10 pairs. Petiole more than 20 mm. Fruits 3-celled. Seeds more than 1. Apex of leaves rounded or acute **44. *S. polyandra***
6. Fruits ampulliform **16–1. *S. cochinchinensis* ssp. *cochinchinensis***
5. Underside of leaves hairy.
8. Leaves distichous **23. *S. fasciculata***
8. Leaves spirally arranged.
9. Leaf margin and petiole beset with closely spaced glands **3. *S. adenophylla***
9. Leaf margin and petiole not so.
10. Fruits ampulliform.
11. Nerves more than 10 pairs. Inflorescence a (basally branched) spike. **16–1. *S. cochinchinensis* ssp. *cochinchinensis***
11. Nerves less than 10 pairs. Inflorescence a fascicle **23. *S. fasciculata***
10. Fruits spindle-shaped or otherwise not ampulliform.
12. Petiole 1–5 mm **34. *S. lancifolia***
12. Petiole more than 5 mm.
13. Bracts and bracteoles caducous. Seeds not straight. Petiole 10–50 mm. **41. *S. odoratissima***

13. Bracts and/or bracteoles persistent. Seeds straight. Petiole 7–8 mm 24. *S. filipes*
 Petiole 5–7 mm 56. *S. vidalii*
4. Twigs glabrous.
14. Underside of leaves hairy 24. *S. filipes*
14. Underside of leaves glabrous.
15. Inflorescence a (basally branched) spike or a cone.
16. Petiole 1–3 mm. Fruit ellipsoid to globose, 3–5 mm. Inflorescence a spike 34. *S. lancifolia*
16. Petiole longer than 3 mm.
17. Petiole 15–25 mm. Inflorescence a spike to 1½ mm long 54. *S. trispala*
17. Petiole shorter than 15 mm or inflorescence longer than 1½ cm.
18. Inflorescence a raceme or panicle of racemes. Embryo curved 42. *S. ophirensis*
18. Inflorescence a spike. Embryo straight or curved.
19. Inflorescence a short spike to 1½ cm. Embryo straight 40. *S. obovatifolia*
19. Inflorescence a spike, longer than 1½ cm. Embryo curved.
- 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
15. Inflorescence not a spike (rarely a cone in bud).
20. Fruits 2–5-celled.
21. Stone with ridges or grooves 27. *S. glabriramifera*
 42. *S. ophirensis*
21. Stone smooth.
22. Acumen shorter than 5 mm. Inflorescence a fascicle to 1½ cm. Bracts persistent. Fruits more than 10 mm long. Seeds straight. 40. *S. obovatifolia*
22. Acumen longer than 5 mm 14. *S. celastrifolia*
20. Petiole 10–15 mm. Leaves 7–20 cm. Inflorescence a panicle. Fruit 8–25 mm, ovoid 41. *S. odoratissima*
20. These characters not combined.
23. Leaves 2–5¾ cm. Fruits ovoid, 5–7 mm 57. *S. whitfordii*
23. These characters not combined.
24. Embryo straight. Leaves 4½–7½ cm. Petiole 7–8 mm 24. *S. filipes*
24. Embryo curved. Leaves 5–22 cm. Petiole 1–10 mm 42. *S. ophirensis*

Celebes & The Moluccas

1. Midrib prominent on the upper surface 35. *S. lucida*
1. Midrib impressed in the upper surface.
2. Twigs hairy.
3. Leaves distichous.
4. Underside of leaves glabrous 33. *S. laeteviridis*
4. Underside of leaves hairy.
5. Fruits ampulliform. Inflorescence a fascicle. Bracts persistent 23. *S. fasciculata*
5. Fruits not ampulliform. Inflorescence not a fascicle. Bracts caducous 33. *S. laeteviridis*
3. Leaves spirally arranged.
6. Leaves crowded towards the end of the twigs 44. *S. polyandra*
6. Leaves evenly distributed.
7. Underside of leaves glabrous. (If leaf margin and petiole beset with closely spaced vesicular glands: 3. *S. adenophylla*.)
8. Seed and embryo twice curved 16–1. *S. cochinchinensis* ssp. *cochinchinensis*
8. Seed and embryo uncinately curved towards the base. 16–4. *S. cochinchinensis* ssp. *leptophylla*
7. Underside of leaves hairy.
9. Upper side of leaves hairy (pulverulent) 3. *S. adenophylla*
9. Upper side of leaves glabrous.
10. Bracts caducous.
11. Stone smooth. Inflorescence a (basally branched) raceme. 42–1b. *S. ophirensis* var. *densireticulata*
11. Stone with ridges or grooves. Inflorescence a panicle of 5–30 cm 41. *S. odoratissima*
10. Bracts persistent.
12. Seeds not straight 16–4. *S. cochinchinensis* ssp. *leptophylla*
12. Seeds straight.
13. Leaf index more than 3. Leaf margin (and petiole) beset with closely spaced glands. Stone ellipsoid 3. *S. adenophylla*
13. Leaf index 2–3. Leaf margin (and petiole) often glandular but glands not closely spaced. Stone ampulliform 23. *S. fasciculata*
2. Twigs glabrous.
14. Underside of leaves hairy.
15. Leaves distichous. Petiole 1–5 mm. Bracts caducous. Seeds straight 33. *S. laeteviridis*
15. Leaves spirally arranged. 16–4. *S. cochinchinensis* ssp. *leptophylla*
14. Underside of leaves glabrous.

- 16. Fruits 2-3-celled.
- 17. Leaves longer than 15 cm. Fruits more than 10 mm long. Leaf margin entire. Nerves 9-14 pairs. Stone with ridges or grooves. Seeds straight. 36. *S. maliliensis*
- 17. Leaves shorter than c. 15 cm. Fruits to c. 10 mm long. Seed and embryo U-shaped. 14. *S. celastrifolia*
- 16. Fruits 1-celled.
- 18. Leaves distichous 33. *S. laeteviridis*
- 18. Leaves spirally arranged.
- 19. Inflorescence a panicle of 5-30 cm 41. *S. odoratissima*
- 19. Inflorescence not a panicle or shorter than 5 cm.
- 20. Fruit stone with high, interrupted ridges which often protrude from the base. 42. *S. ophirensis*
- 20. Stone different 16. *S. cochinchinensis*

New Guinea
(incl. New Ireland & New Britain)

- 1. Leaves (pseudo-)verticillate 30. *S. herzogii*
- 1. Leaves not verticillate.
- 2. Twigs glabrous.
- 3. Underside of leaves hairy 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 3. Underside of leaves glabrous.
- 4. Nerves 13-20 pairs. Leaves 21-62 cm 26. *S. gigantifolia*
- 4. Nerves less than 15 pairs. Leaves usually much smaller.
- 5. Twigs thick.
- 6. Acumen shorter than 5 mm. Fruits c. 13 mm long. Nerves 8-12 pairs 45. *S. pulvinata*
- 6. Acumen longer than 5 mm. Fruits to c. 10 mm long. 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 5. Twigs not thick.
- 7. Bracts persistent.
- 8. Inflorescence a panicle to 5 cm. Petiole 13-15 mm. Nerves 5-9 pairs 18. *S. composiracemosa*
- 8. Plant different 16. *S. cochinchinensis*
- 7. Bracts caducous.
- 9. Fruits c. 15 mm long 21. *S. cylindracea*
- 9. Fruits to c. 10 mm long.
- 10. Fruits 3-celled (often 1 or 2 aborted) 14. *S. celastrifolia*
- 10. Fruits 1-celled. 16-3. *S. cochinchinensis* ssp. *thwaitesii*
- 2. Twigs hairy.
- 11. Underside of leaves glabrous.
- 12. Inflorescence only 1-flowered.
- 13. Leaves shorter than 5 cm 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 13. Leaves longer than 5 cm.
- 14. Leaf index less than 2. Acumen shorter than 5 mm. Angle of leaf base less than 90°. Nerves less than 5 pairs. Reticulation coarse. Fruits to c. 10 mm long. Seeds not straight. Apex of leaves rounded or acute 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 14. Leaf index more than 2. Acumen longer than 5 mm. Angle of leaf base more than 90°. Nerves more than 5 pairs. Reticulation fine. Fruits 17-22 mm long. Seeds straight. Apex of leaves acuminate 38. *S. multibracteata*
- 12. Inflorescence more-flowered.
- 15. Petiole 0-5 mm 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 15. Petiole more than 5 mm.
- 16. Seed and embryo (twice) curved 16-1. *S. cochinchinensis* ssp. *cochinchinensis*
- 16. Seed and embryo uncinately curved towards the base. 16-4. *S. cochinchinensis* ssp. *leptophylla*
- 11. Underside of leaves hairy.
- 17. Upper side of leaves hairy 43. *S. paucistaminea*
- 17. Upper side of leaves glabrous.
- 18. Inflorescence only 1-flowered.
- 19. Leaf index more than 3. Angle of leaf base less than 90°. Reticulation coarse. 49. *S. salicioides*
- 19. Leaf index 2-3. Angle of leaf base more than 90°. Reticulation fine 38. *S. multibracteata*
- 18. Inflorescence more-flowered.
- 20. Bracts caducous. Seeds straight 15. *S. cerasifolia*
- 20. Bracts persistent. Seeds not straight.
- 21. Seed and embryo (twice) curved 16-1. *S. cochinchinensis* ssp. *cochinchinensis*
- 21. Seed and embryo uncinately curved towards the base. 16-4. *S. cochinchinensis* ssp. *leptophylla*

3. *Symplocos adenophylla* WALL. (Cat. 1831, n. 4427A, *nomen*) ex G. DON, Gen. Syst. 4 (1837) 3; DC. Prod. 8 (1844) 257; MIQ. Fl. Ind. Bat. 1, 2 (1859) 466; CLARKE, Fl. Br. Ind. 3 (1882) 575; BRAND, Pfl. R. Heft 6 (1901) 48, incl. *var. virgata* WALL. (Cat. 1831, n. 4427B, *nomen*) ex BRAND; K. & G. J. As. Soc. Beng. 74, ii (1906) 240; BRAND, Bull. Herb. Boiss. II, 6 (1906) 747, incl. *var. atrata* BRAND, l.c. 748; MERR. Philip. J. Sc. 2 (1907) Bot. 298; BRAND, Philip. J. Sc. 3 (1908) Bot. 7, incl. *var. merrittii* BRAND; RIDL. Fl. Mal. Pen. 2 (1923) 303, t. 101, incl. *var. montana* RIDL.; NOOT. Leid. Bot. Ser. 1 (1975) 121. — *S. bancana* MIQ. Fl. Ind. Bat. Suppl. 1 (1861) 476. — *S. iteophylla* MIQ. l.c., incl. *var. rostrata* MIQ. et *var. elliptica* MIQ.; MERR. En. Born. (1921) 486. — *Eugeniodes adenophyllum* O. K. Rev. Gen. Pl. 2 (1891) 410. — *S. beccarii* BRAND, Pfl. R. Heft 6 (1901) 49. — *S. constricta* BRAND, l.c. 41; MERR. En. Born. (1921) 486. — *S. fulvosa* KING & GAMBLE, J. As. Soc. Beng. 74, ii (1906) 233; RIDL. Fl. Mal. Pen. 2 (1923) 300. — *S. palawanensis* BRAND, Philip. J. Sc. 3 (1908) Bot. 10; MERR. En. Philip. 3 (1923) 301. — *S. pruniflora* RIDL. J. Fed. Mal. St. Mus. 4 (1909) 46; Fl. Mal. Pen. 2 (1923) 304. — *S. brandii* ELMER, Leaf. Philip. Bot. 4 (1912) 1477. — *S. pahangensis* BRAND in Fedde, Rep. 14 (1916) 326. — **Fig. 7.**

Shrub or tree to 20 m, 50 cm \varnothing . Young twigs pulverulent-puberulous or rarely tomentellous, glabrescent, often dark-brown to blackish. Innovations light reddish-brown. *Leaves* chartaceous to coriaceous, often dark brown when dry, pulverulent beneath or on both faces, soon glabrescent, elliptic, acuminate, with cuneate base and recurved to revolute margin with many pellucid glands, $4\frac{1}{2}$ –16 by $1\frac{1}{4}$ – $4\frac{3}{4}$ cm; nerves 4–12 pairs, meeting in a looped intramarginal vein; petiole 6–12 mm. *Flowers* in a spike, raceme or panicle to 6 cm; indument of axis as twigs. Bracts and bracteoles with same indument persistent in fruit, $\frac{1}{2}$ –1 mm. Pedicel mostly only under older flowers, to 3 mm. *Calyx* nearly entirely divided into $\frac{1}{2}$ –1 mm long lobes. *Corolla* 2–5 mm. *Stamens* (20)–25–50. Disk glabrous or rarely hairy. *Ovary* with same indument as that of twigs, 1–2 mm high; style glabrous or with some hairs towards the base, 2–4 mm. *Fruit* ellipsoid to cylindrical, sometimes with c. 6 ridges when dry, blue or black-purple, soon glabrescent, crowned by the incurved calyx lobes, with only one developed cell, 8–10(–11) by 3–5(–6) mm. *Seed* 1, with straight embryo.

Distr. Continental Asia (China incl. Hainan, Indo-China, Thailand), throughout *Malesia*, except Java (but found in Bawean I.), the Lesser Sunda Is. and New Guinea. A variety in Indo-China.

Ecol. Usually in montane rain-forest, in mountain heaths, on ridge-crests and ridges, and mossy forest, also in *Baeckea-Leptospermum* heath forest, often on granite, but also on ultra-basic (Trusmadi), from sea-level to 3000 m, but at low altitude largely on podsolized sand (Banka; Bako N. P.) and in heath forest on humid podsol. *Fl.* Sept. (Febr.–Oct.), *fr.* May (Jan.–Dec.).

As is the case with more species, dwarfed specimens or hardly 1 m high may already come into flower.

Uses. The timber can be used for light constructions (DESCH, Mal. For. Rec. 15², 1954, 593).

Vern. & Uses. *Mëndong*, *ménugan*, Malaya,

kaju lattan, *k. porugis*, Sumatra, Batak, *kayu kain*, W. Borneo, G. Klamm; the latter name alluding to the use for tanning cloth in dyeing.

The Besisi (Mal. Pen.) believe that the leaves of certain plants, e.g. *S. adenophylla*, if carried in the quiver with their darts, act as charms bringing them success in hunting (BURK. Dict. 1935).

4. *Symplocos anomala* BRAND, Bot. Jahrb. 29 (1900) 529; Pfl. R. Heft 6 (1901) 67; NOOT. Leid. Bot. Ser. 1 (1975) 126, pl. 1a–f, with full synonymy. — *S. concolor* BRAND, Pfl. R. Heft 6 (1901) 65; K. & G. J. As. Soc. Beng. 74, ii (1906) 242; RIDL. Fl. Mal. Pen. 2 (1923) 304. — **Fig. 7.**

Shrub or tree to 21 m, 40 cm \varnothing . Young twigs tomentellous to tomentose or appressedly pubescent, glabrescent. *Leaves* glabrous, brownish or olive to yellowish green glossy above, elliptic, acuminate with cuneate-attenuate base and more or less revolute finely glandular dentate to nearly entire margin, $2\frac{1}{2}$ –12 by $1\frac{1}{4}$ –3 cm; midrib prominent above or flat, rarely flat and sunken; nerves 5–11 pairs, meeting in a looped intramarginal vein; petiole 2–7 mm. *Raceme* to 2 cm long, axis tomentose to appressedly pubescent. Bracts 1–2 mm, bracteoles $\frac{1}{4}$ – $1\frac{1}{2}$ mm, both persistent, with same indument as axis. Pedicels 2–5 mm. *Calyx* lobes rounded, ciliate $\frac{1}{2}$ –2 mm. *Corolla* 4–6 mm. *Stamens* 50 to more than 100. Disk tomentose or shortly soft hairy. *Ovary* tomentose to (finely) appressedly pubescent, c. $\frac{1}{2}$ – $1\frac{1}{2}$ mm high; style glabrous or hairy towards the base, 4–7 mm. *Fruit* 3-celled, ellipsoid, violet, almost black, c. 10 by 6 mm in Malaya, 10–13 by 6–8 mm in Borneo. *Seed* 1 in each cell, straight with straight embryo.

Distr. Continental Asia (Burma, Thailand, Indo-China, China incl. Hainan, Japan, Ryu Kyu Is., Formosa) and *Malesia*: Malaya (incl. Penang), N. Sumatra (incl. Banka), and Borneo.

Ecol. Mixed evergreen montane forest, also on ridges and along stream-sides, 700–2200 m (in continental Asia to 3000 m), but also found on podsolized sands at very low altitude, 20–50 m, in Banka. *Fl.* June–Oct., *fr.* Jan.–Dec.

Vern. *Rénak*, Banka.

5. *Symplocos atjehensis* NOOT. Leid. Bot. Ser. 1 (1975) 128. — **Fig. 7, 8.**

Treelet to c. 8 m, 10 cm \varnothing . Twigs glabrous or tomentose. *Leaves* glabrous or sparsely appressedly hairy, especially on midrib and nerves, elliptic, acuminate, with acute to rounded base and dentate margin, 8–21 by $3\frac{1}{2}$ –6 cm; nerves 8–12 pairs, meeting in a looped intramarginal vein; petiole 12–17 mm. *Flowers* in fascicles with persistent reddish-brown tomentose to pubescent c. 2 mm long bracts and bracteoles. *Calyx* 2 mm, the (ciliate) lobes $1\frac{1}{2}$ mm. *Corolla* c. 5 mm. *Stamens* c. 50. Disk glabrous. *Ovary* glabrous without, c. 1 mm high; style glabrous, 4–6 mm. *Fruit* ellipsoid, 10–12 by 5–6 mm, 3-celled, but only one cell developing; stone shallowly lengthwise ribbed. *Seed* 1, straight with straight embryo.

Distr. *Malesia*: N. Sumatra (Gajo Lands).

Ecol. Mixed evergreen mountain forest, 1700–2850 m. *Fl.* Aug.–Sept., *fr.* July.

6. *Symplocos barisanica* NOOT. Leid. Bot. Ser. 1 (1975) 130. — **Fig. 7.**

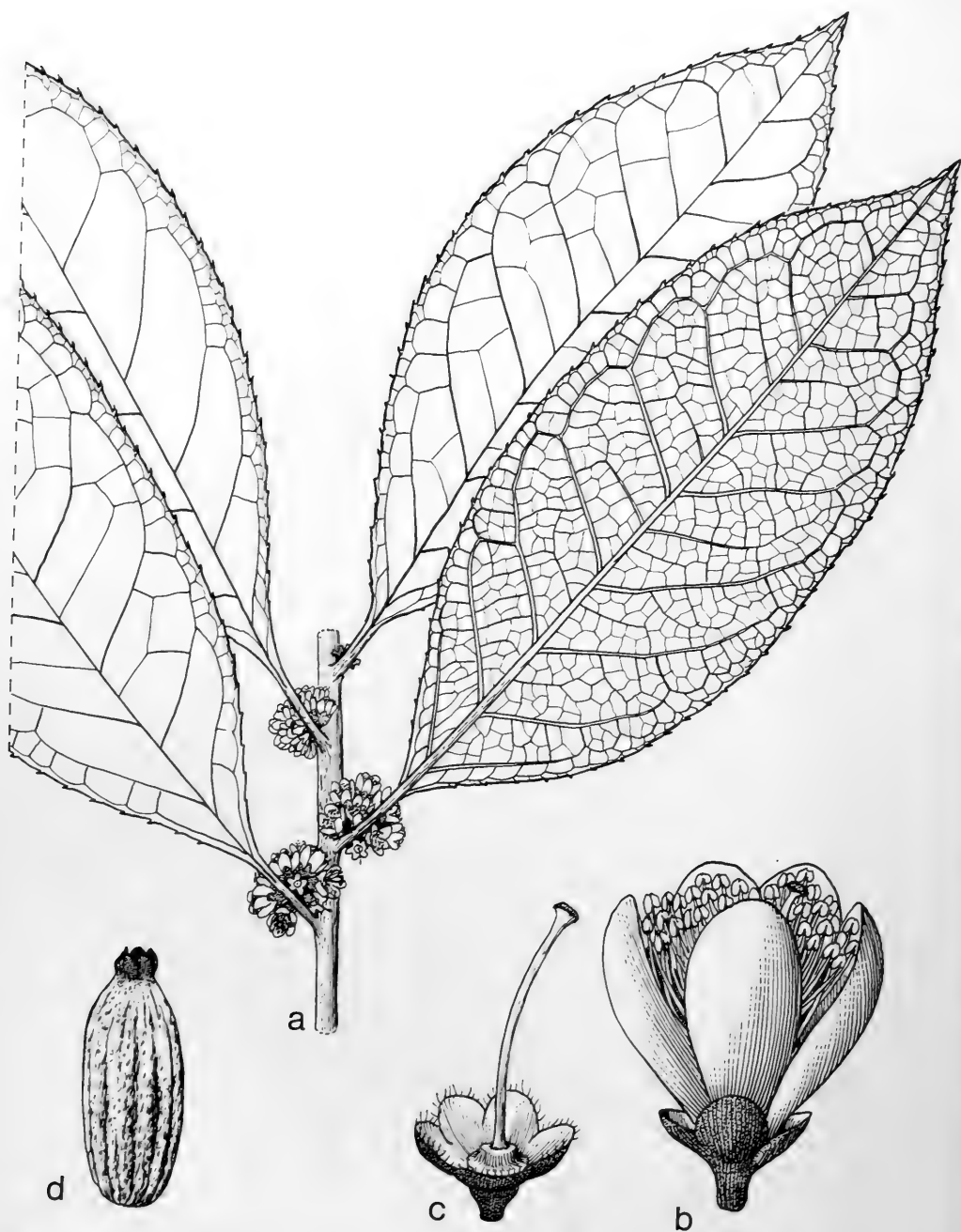


Fig. 8. *Symplocos atjehensis* NOOT. a. Habit, nat. size, b. flower, c. *ditto* after removal of petals and stamens, both $\times 6$, d. fruit, $\times 3$ (a-c VAN STEENIS 6529, d DE WILDE 13773).



Fig. 9. *Symplocos batakensis* NOOT. a. Habit, nat. size. — *S. barringtoniifolia* BRAND. b. Fruit, c. ditto in CS, both $\times 1\frac{1}{2}$ (a ROBINSON & KLOSS 125, b-c KEP/FRI 10736).

Small tree, 6–10 m, 25 cm \varnothing . Twigs glabrous. *Leaves* glabrous, elliptic, with acute to nearly rounded base, denticulate margin and acuminate to rounded apex, 12–20 by 5–12 cm; nerves 8–12 pairs, whether meeting in an intramarginal vein or not; petiole 10–30 mm. *Spike* branched, to 5 cm with minutely appressed hairy axis. Bracts and bracteoles persistent, \pm ovate, with same indument, 2–3 mm long. *Calyx* divided into semi-orbicular, glabrous but ciliate $1\frac{1}{2}$ –2 mm long lobes. *Corolla* c. 6 mm. *Stamens* c. 50. Disk glabrous. *Ovary* c. 1 mm high, glabrous; style glabrous, 4–5 mm, or reduced. *Fruit* ovoid to globose, c. 10 by 9 mm with globose to ampulliform stone of c. 8 by 7 mm (the neck c. 2 mm long and the belly irregularly lengthwise grooved, c. 6 mm high). *Seed* 1, U-shaped with U-shaped embryo.

Distr. *Malesia*: Central W. Sumatra (Mts Kerintji and Merapi).

Ecol. Montane rain-forest, on Mt Kerintji in *Gleichenia* woodland, 2000–2600 m. *Fl.* June–July.

7. *Symplocos barringtoniifolia* BRAND, Ann. Cons. Jard. Bot. Genève 4 (1904) 283; NOOT. Leid. Bot. Ser. 1 (1975) 131, pl. 4. — *Doxomma rigidum* MIERS, Trans. Linn. Soc. II, Bot. 1 (1875) 104. — *Barringtonia rigida* CLARKE, Fl. Br. Ind. 2 (1879) 510. — *S. rigida* CLARKE, Fl. Br. Ind. 3 (1882) 581, non G. DON, 1837; BRAND, Pfl. R. Heft 6 (1901) 52; K. & G. J. As. Soc. Beng. 74, ii (1906) 246; RIDL. Fl. Mal. Pen. 2 (1923) 306. — *Eugeniodes rigidum* O. K. Rev. Gen. Pl. 2 (1891) 976. — Fig. 7, 9b–c.

Tree to 25 m, 40 cm \varnothing . Twigs glabrous, often marked with prominent orbicular scars of fallen leaves; growth discontinuous, terminal buds protected by leathery scales, leaving conspicuous scars. *Leaves* glabrous, elliptic to obovate with cuneate base and acuminate apex, 15–35 by 6–11 cm; nerves 10–14(–16) pairs; petiole 2–5 cm. *Spike* resembling a cone in bud because of the large bracts, becoming $5\frac{1}{2}$ –(8) cm; axis tomentose. Bracts and bracteoles tomentellous to appressedly pubescent, both soon caducous, broadly ovate, 6–10 by 6 mm and narrowly ovate, $2\frac{1}{2}$ –5 mm long respectively. *Calyx* tomentellous, 3– $3\frac{1}{2}$ mm long, the 5 lobes originally c. 1 mm long but the calyx becoming 2–3-lobed by tearing. *Corolla* 4–6 mm. *Stamens* c. 60 to more than 100. Disk glabrous. *Ovary* glabrous, 1– $1\frac{1}{2}$ mm high; style c. 5 mm, with soft hairy conical base. *Fruit* ovoid or ellipsoid, royal blue, $2\frac{1}{2}$ –4 by $1\frac{1}{2}$ –2 cm, with chartaceous mesocarp; stone stellate in cross-section with 8 very high ridges; cells 3, often only 1 fertile. *Seed* straight with straight embryo.

Distr. Continental Asia (Indo-China), in *Malesia*: Malay Peninsula and Borneo (only once: W. Kutei).

Ecol. Lowland rain-forest, river valleys in low undulating country, on hillsides on clay, on dry hillocks in *Dryobalanops* forest, but also on sandstone or granite, mostly below 300 m, but also in Malaya more rarely in montane forest up to 1500 m. *Fl.* July–Aug., *fr.* Febr.–May (July).

VERN. *Médang*, Malaya.

8. *Symplocos batakensis* NOOT. Leid. Bot. Ser. 1 (1975) 132. — Fig. 7, 9a, 10a–d.

Twigs glabrous. *Leaves* often coriaceous, glab-

rous, elliptic (to obovate) with acute base, entire margin and acuminate apex, 6–10 by 2– $4\frac{1}{2}$ cm; nerves 7–10 pairs, meeting in an intramarginal vein; petiole 5–8 mm. *Raceme* to 8 cm, axis glabrous or sparsely minutely pilose. Bracts and bracteoles with same indument, ovate, caducous, $1\frac{1}{2}$ and 1 mm respectively. Pedicel to 2(–5) mm. *Calyx* glabrous, $1\frac{1}{2}$ mm long, the semi-orbicular lobes 1– $1\frac{1}{4}$ mm long. *Corolla* c. 6 mm. *Stamens* c. 100. Disk shortly pilose. *Ovary* glabrous, $1\frac{1}{2}$ mm high; style glabrous, c. 5 mm, sometimes reduced. *Fruit* nearly globose, c. 10 by 8 mm, or ellipsoid-ampulliform, c. 10 by 5 mm, 3-celled, often only 1 cell fertile. *Seed* often only 1, straight with straight embryo.

Distr. *Malesia*: Central W. Sumatra (Tapanuli and Westcoast Res.).

Ecol. Montane rain-forest on low ridges, 1200–1700 m. *Fr.* Jan., Aug.

Vern. *Loala lola*, *sihondung*, Tapanuli.

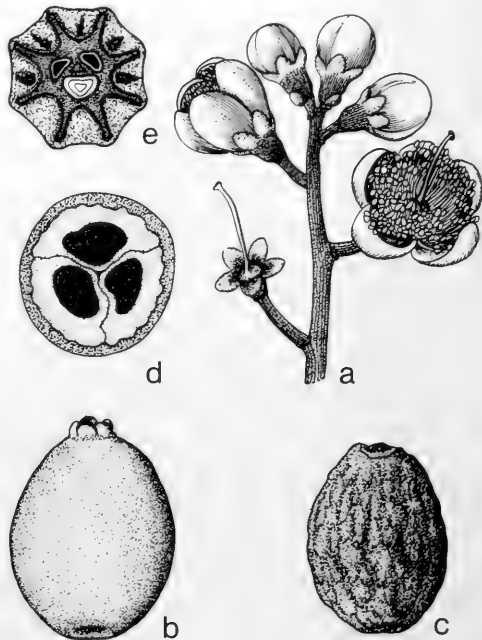


Fig. 10. *Symplocos batakensis* NOOT. a. Flowers and buds, b. fruit, c. endocarp, d. *ditto* in CS, all $\times 2$. — *S. cerasifolia* WALL. ex DC. e. Fruit in CS, nat. size (a–d ROBINSON & KLOSS 125, e SAN 45168).

9. *Symplocos borneensis* BRAND, Pfl. R. Heft 6 (1901) 56; MERR. En. Born. (1921) 486; NOOT. Leid. Bot. Ser. 1 (1975) 134. — Fig. 7.

Twigs glabrous. *Leaves* narrowly elliptic, glabrous, with acute base, entire margin and rounded to faintly acuminate apex (the acumen with broad rounded tip), $4\frac{3}{4}$ –8 by $1\frac{3}{4}$ – $2\frac{1}{2}$ cm; nerves 6–9 pairs, faintly prominent beneath, meeting in an intramarginal vein; reticulation hardly prominent;

petiole 3–4 mm. *Raceme* lax, to 5 cm, axis minutely sparsely hairy to glabrous. Bracts and bracteoles caducous, glabrous, ciliate, c. 1 and c. $\frac{1}{2}$ mm long respectively. Pedicel to 2 mm. *Calyx* glabrous, divided into $\frac{3}{4}$ –1 mm long ciliate lobes. *Corolla* c. 5 mm. *Stamens* 60–80. Disk shortly pilose. *Ovary* glabrous, 1–1 $\frac{1}{4}$ mm high; style glabrous except the conical shortly pilose base, c. 5 mm long. *Fruit* unknown.

Distr. *Malesia*: Borneo (Sarawak and W. Borneo: Kenepai), 2 collections.

Ecol. Lowland rain-forest.

Note. A sterile collection from Central Celebes (Malili) possibly belongs to this species.

10. *Symplocos brachybotrys* MERR. J. Str. Br. R. As. Soc. n. 76 (1917) 110; En. Born. (1921) 486; HEINE, Pfl. Samml. Clemens (1953) 87; NOOT. Leid. Bot. Ser. 1 (1975) 134. — Fig. 7.

Twigs (sparsely) appressedly pubescent in innovations, soon glabrescent. *Leaves* sparsely appressedly fine hairy when young, soon glabrescent, ovate to elliptic, with acute to rounded base, denticulate margin and acute to acuminate apex, 4–6 by 2–3 $\frac{1}{4}$ cm; nerves 6–9 pairs, meeting in an intramarginal vein; petiole 3–4 mm. *Spike* short, 1–3-flowered, axis at most 7 mm, appressedly pubescent, or flowers solitary, sessile from the leaf axils and then several appressedly pubescent 2–4 mm long bracts. Bracts and bracteoles caducous, in the spikes not seen. *Calyx* appressedly pubescent, divided into the c. 3 mm long lobes. *Corolla* 6 mm. *Stamens* c. 100. Disk glabrous, inconspicuous. *Ovary* appressedly pubescent, 1 mm high; style glabrous, c. 4 mm. *Fruit* ovoid to ellipsoid, intense indigo-blue, c. 10 by 5 mm, stone shallowly lengthwise grooved. *Seed* 1, ovoid, slightly curved with S-shaped embryo.

Distr. *Malesia*: Borneo (Sarawak and Sabah: Mt Kinabalu).

Ecol. Mixed, evergreen mountain forest, 1500–1800 m.

11. *Symplocos brandisii* K. & V. Bijdr. 7 (1900) 157; BRAND, Pfl. R. Heft 6 (1901) 90; KOORD. Atlas 2 (1914) t. 381; BACK. & BAKH. f. Fl. Java 2 (1965) 206; NOOT. Leid. Bot. Ser. 1 (1975) 135, pl. 5. — *S. koodersiana* BRAND, Bull. Herb. Boiss. II, 6 (1906) 748. — *S. pseudoclethra* HALL. f. Med. Rijksherb. 14 (1912) 41.

Tree to 30 m, 40 cm Ø. Twigs glabrous. *Leaves* glabrous, mostly narrowly elliptic, with attenuate base, (coarsely) crenate margin and hardly acuminate apex, ($\frac{5}{2}$ –)7–13(–22) by 2 $\frac{1}{2}$ –5(–6 $\frac{1}{2}$) cm; nerves (7–)10–16(–18) pairs, meeting in a looped intramarginal vein; petiole 6–15 mm. *Raceme* to 10 cm, but often shorter, axis (sparsely) pubescent. Bracts very soon caducous, appressedly pubescent, obovate or elliptic, 1–4 mm; bracteoles falling after the bracts, sometimes rather long persistent, less hairy, (broadly) ovate to narrowly elliptic, 1–2 $\frac{1}{2}$ mm. Pedicels pubescent, at most 6 mm but often shorter. *Calyx* glabrous, or some appressed hairs on the base of the tube, 1 $\frac{1}{2}$ –2 $\frac{1}{2}$ mm long, the lobes c. $\frac{1}{4}$ mm shorter, sometimes ciliate. *Corolla* c. 4(–5) mm. *Stamens* 60 to more than 100. Disk 5-glandular, glabrous. *Ovary* glabrous, 1–1 $\frac{1}{2}$ mm high; style glabrous or with few hairs, but the conical base soft-hairy, 4–5 mm. *Fruit*

ovoid to ellipsoid, slightly narrowed towards the apex, 10–16 by 5–7 mm; stone 1-celled, smooth or faintly ribbed. *Seeds* 1 (or 2), filling the whole stone, ovoid, with straight embryo.

Distr. *Malesia*: Java and Lesser Sunda Is. (Lombok).

Ecol. From sea-level to 1800 m.

KEY TO THE VARIETIES

1. Leaves 5 $\frac{1}{2}$ –13 cm. Bracts obovate, 1–3 mm. Stamens c. 60 a. var. *brandisii*
1. Leaves 11–22 cm. Bracts elliptic, 3–4 mm. Stamens more than 100 b. var. *pseudoclethra*

a. var. *brandisii*. — *S. brandisii* K. & V. — *S. koodersiana* BRAND. Cf. NOOT. Leid. Bot. Ser. 1 (1975) 136, pl. 5a–h. — Fig. 7.

Leaves 5 $\frac{1}{2}$ –13 cm long. Nerves 7–16 pairs. Bracts obovate, 1–3 mm; bracteoles ovate to narrowly elliptic, 1–2 $\frac{1}{2}$ mm. *Corolla* c. 4 mm. *Stamens* c. 60.

Distr. *Malesia*: West Java (Ujung Kulon Peninsula, Peutjang I. and Depok), East Java (Besuki: Pantjur Idjen), and Lesser Sunda Is. (Lombok: Mt Rindjani).

Ecol. Lowland primary and secondary forest, in P. Peutjang on raised coral, in Java below 200 m, in Lombok in montane forest at '800–1800 m'. *Fl.* March–June, Nov., fr. July.

b. var. *pseudoclethra* (HALL. f.) NOOT. Leid. Bot. Ser. 1 (1975) 136, pl. 5i–j. — *S. pseudoclethra* HALL. f.

Leaves 11–22 cm. Nerves 11–18 pairs. Bracts elliptic, boat-shaped, 3–4 mm; bracteoles broadly ovate, c. 2 mm. *Corolla* 1 $\frac{1}{2}$ mm. *Stamens* more than 100.

Distr. *Malesia*: Lesser Sunda Is. (Lombok: Mt Rindjani). Only known from the type.

Ecol. Montane high forest, 800–950 m. *Fl.* April.

12. *Symplocos buxifolia* STAFF, Trans. Linn. Soc. Bot. 4 (1894) 206; BRAND, Pfl. R. Heft 6 (1901) 64; MERR. En. Born. (1921) 487; NOOT. Leid. Bot. Ser. 1 (1975) 136, pl. 6a–d. — Fig. 7.

Shrub or treelet, 2–10 m; crown dense, globular, fastigate. Twigs glabrous, dark, \pm zigzag. *Leaves* glabrous, closely placed, elliptic to nearly orbicular with more or less attenuate base, finely glandular dentate or crenate margin and rounded to acute or slightly acuminate apex, 15–50 by 7–25 mm; nerves 4–6 pairs, meeting in an intramarginal vein; petiole 3–7 mm. *Inflorescence* an axillary few-flowered raceme or often a 1-flowered shoot with several miniature sparsely pubescent to glabrous bract-like leaves of 3 by 1 to 10 by 5 mm; axis glabrous or minutely appressedly hairy. Bracts and bracteoles caducous; pedicel between them to 2 mm. *Calyx* glabrous or finely appressedly hairy, 2–5 mm long, the lobes ciliate, 1–3 mm. *Corolla* 5–8 mm. *Stamens* 70 to more than 100. Disk glabrous. *Ovary* glabrous or rarely finely appressedly hairy, 2–3 mm high; style glabrous, 3–7 mm. *Fruit* ellipsoid to ovoid, 10–15 by 6–8 mm; stone with low lengthwise ridges. *Seed* 1, straight with straight embryo.

Distr. *Malesia*: N. Borneo (Sabah: Mt Kinabalu).

Ecol. Mixed, evergreen, subalpine low forest and scrub, common, 2400–4000 m. *Fl.* March–July, Oct., Dec., *fr.* Febr.–Aug.

Note. This species can hardly be distinguished from the mountain forms of *S. cochinchinensis* ssp. *leptophylla* in New Guinea, especially those with small orbicular leaves.

13. *Symplocos calycodactylos* BRAND, Pfl. R. Heft 6 (1901) 63; NOOT. Leid. Bot. Ser. 1 (1975) 137, pl. 6e.

Shrub, 3 m. Twigs densely spreading long-hairy, hairs to 3 mm. *Leaves* long-hairy on both surfaces, ovate to elliptic with rounded to subcordate base, dentate, long-ciliate margin and acuminate apex, 6–14 by $2\frac{1}{2}$ –5 cm; nerves 7–8 pairs, meeting in an intramarginal vein; petiole 3–5 mm. *Inflorescence* a fascicle (or flowers solitary?) or raceme to 10 cm; axis long-hairy. Bracts and bracteoles soon caducous, to 7 mm long, narrowly elliptic clothed with long hairs. Pedicels from 25 mm in fascicles to 13 mm in racemes. *Calyx* entirely divided into the narrow-elliptic to linear, 4–6 mm long pubescent lobes. *Corolla* c. 6 mm. *Stamens* c. 100. Disk pilose. *Ovary* obscured by the 3 mm long hairs, $1\frac{1}{2}$ mm high; style glabrous, c. 8 mm. *Fruit* \pm cylindrical, densely long-hairy, crowned by the persistent calyx (only young fruits seen).

Distr. *Malesia*: Malay Peninsula (Perak and Kedah), 2 collections.

Ecol. Evergreen hill forest, 900–1000 m. *Fl.* Febr.

Note. Closely allied to the Indian-Ceylonese *S. pulchra* WIGHT with which there are hardly any vegetative differences; in flower easily distinguished by the extremely long calyx lobes.

14. *Symplocos celastrifolia* GRIFF. ex CLARKE, Fl. Br. Ind. 3 (1882) 575; BRAND, Pfl. R. Heft 6 (1901) 48; K. & G. J. As. Soc. Beng. 74, ii (1906) 239; RIDL. Fl. Mal. Pen. 2 (1923) 302; MERR. Un. Cal. Publ. Bot. 15 (1929) 248; FLETCHER, Fl. Siam. En. 2 (1938) 385; NOOT. Leid. Bot. Ser. 1 (1975) 138. — *Eugeniodes celastrifolius* O. K. Rev. Gen. Pl. 2 (1891) 975. — *S. nigricans* BRAND, Pfl. R. Heft 6 (1901) 49. — *S. candicans* BRAND, l.c. — *S. hutchinsonii* BRAND, Philip. J. Sc. 4 (1909) Bot. 109; MERR. En. Philip. 3 (1923) 299. — *S. peninsularis* BRAND, Philip. J. Sc. 4 (1909) Bot. 110. — Fig. 4m, 7, 11.

Shrub or small tree, rarely up to 30 m high and 60 cm \varnothing . Twigs glabrous. *Leaves* glabrous, or rarely sparsely fine-hairy on midrib and nerves beneath, often the upper surface dark coloured to nearly black when dry and the undersurface olive brown, \pm elliptic, with cuneate-attenuate base, crenate margin and mostly abruptly acuminate apex, $5\frac{1}{2}$ –15 by $2\frac{1}{4}$ –6 cm; nerves 6–9 pairs,



Fig. 11. *Symplocos celastrifolia* GRIFF. ex CLARKE. a. Habit, $\times \frac{2}{3}$, b. bud, with bract and bracteoles, c. corolla and stamens, both $\times 3$, d. anther, e. stigma, both $\times 9$, f. LS of flower, $\times 5$, g. CS of fruit, h. LS of fruit, both $\times 9$ (a MAIN 1258, b–h KOSTERMANS 1144, all from Morotai I.).

usually meeting in the intramarginal reticulation; petiole 3–15 mm. *Raceme* often basally branched, axis fine-hairy to appressedly pubescent, 3–12 cm. Bracts and bracteoles soon caducous, 2–3(–4 in Morotai) and c. $1\frac{1}{2}$ (or 2– $2\frac{1}{2}$ in Morotai) mm long respectively. Pedicels with same indument as axis, 1–5 mm. *Calyx* glabrous, $1\frac{1}{2}$ – $2\frac{1}{2}$ (–3 in Morotai) mm; lobes ciliate, when young 1– $1\frac{1}{2}$ mm, becoming longer by tearing apart. *Corolla* 4–6 mm. *Stamens* 40–c. 60. Disk glabrous, with some hairs or pilose, especially after anthesis. *Ovary* glabrous, c. 1 mm high; style glabrous, 4–5 mm. *Fruit* orbicular, pink, green, yellow or dark blue (sec. coll.), 4–10(–20) by 3–8(–15) mm; stone smooth, cells 3, but usually only 1 fertile, the sterile cells larger than the fertile ones, towards the base filled with air. *Seed* and embryo U-shaped.

Distr. Peninsular Thailand and throughout *Malesia*, except in Java, the Lesser Sunda Is., the northern islands of the Philippines, the northern half of Celebes, and most of the Moluccas. The number of collections in Sumatra and East Malesia (E. of Makassar Straits) is small compared with those in Malaya and especially Borneo.

Ecol. Usually in coastal, primary and secondary lowland forests especially in the transition zone between mangrove (*Nypa*) and freshwater swamps, mostly in deep marshy, sandy soils, but in a variety of other habitats: sandy beaches, sandbanks near the sea, kerangas, *Casuarina* peat swamp, in lalang fields on white sandy soils, open heath forest behind the mangrove, in *Shorea laevifolia* forest (Nunukan), on a dry bamboo ridge at 300 m, also on red or yellow sandy loams, exceptionally as high as 750 m, and even 1900 m. *Fl.* March–May (June–Jan.), *fr.* June–Aug. (Sept.–Jan.). Flowers are noted to be fragrant. The fruits are obviously buoyant, the sterile cells being filled with air.

Vern. Sumatra: *këndung*, Palembang, *krunjing*, Banka; Borneo-Sarawak: *purup*, Lundu; Sabah: *kayu tanyong*, *kulimbabok*, *tandjong jawa*, *tanjong-tanjong*, M., *mangkasugoi*, Mub., *songal*, Tenggara, *inderatan*, Bajau, *balas*, Banggi, *enadak*, *inderopis*, *lamai-lamai*, *mata kinai*, *tukil-tukil*, Dusun; Kalimantan: *adad*, Nunukan, *bingtanggantantai*, E. Kutei, *mangkinang tikus*, Kahajan, *tawi*, Sampit.

Notes. In Morotai I. a differing population is found, with tomentose axis of raceme and bracts and calyx lobes longer than in other specimens, and growing at 800–1000 m. *Fig.* 11.

Also in West New Guinea (Vogelkop Peninsula) deviating specimens are found with large, thicker-walled fruits at c. 1900 m.

15. *Symplocos cerasifolia* WALL. (Cat. 1831, n. 4434, *nomen*) ex DC. Prod. 8 (1844) 257; Miq. Fl. Ind. Bat. 1, 2 (1859) 466, *excl. stirp.* Zoll.; CLARKE, Fl. Br. Ind. 3 (1882) 580; BRAND, Pl. R. Heft 6 (1901) 52; K. & G. J. As. Soc. Beng. 74, ii (1906) 245; RIDL, Fl. Mal. Pen. 2 (1923) 306; NOOT, Leid. Bot. Ser. 1 (1975) 140, pl. 7c–f. — *Bobua cerasifolia* MIERS, J. Linn. Soc. Bot. 17 (1879) 304. — *Eugeniodes cerasifolium* O. K. Rev. Gen. Pl. 2 (1891) 975. — **Fig. 7, 10e.**

a. var. *cerasifolia*. — **Fig. 7, 10e.**

Tree to 25 m, 35 cm Ø. Twigs often spreadingly thin-pilose in innovations; growth discontinuous; terminal buds with many leathery scales, the latter

leaving conspicuous scars. *Leaves* long spreadingly to more or less appressedly pilose beneath, especially on midrib and nerves, sometimes entirely glabrous, with cuneate base, sharply dentate margin and acuminate apex, 7–16(–22) by 2–5(–7) cm; nerves 6–9 pairs, meeting in a distinct looped intramarginal vein; petiole slender, 15–25 mm. *Spike* resembling a short cone in bud as in *S. barringtoniifolia*, becoming at most 3 cm long; axis ± appressedly long pilose to densely pubescent. Bracts broadly ovoid to orbicular, boat-shaped, appressedly (silky-)pubescent on the back, at least in the middle, c. 5 by 5 mm; bracteoles with same indument, narrowly elliptic, c. 3 mm long, both soon caducous. *Calyx* glabrous or slightly pubescent, $2\frac{1}{2}$ –4 mm, the lobes initially 1– $1\frac{1}{2}$ mm, becoming often as long as the calyx by tearing apart. *Corolla* c. 5 mm. *Stamens* 30 to more than 100. Disk glabrous. *Ovary* glabrous, 1– $1\frac{1}{2}$ mm high; style glabrous, but the conical base sometimes hairy. *Fruit* ellipsoid, shiny blue, 22–40 by 8–18 mm; stone with 8 high ridges, 3-celled with a central canal, often only one cell developed. *Seed* cylindrical, with straight embryo.

Distr. Extreme south of Peninsular Thailand; in *Malesia*: Sumatra (also Banka), Malay Peninsula, Borneo, and West New Guinea (once, near Merauke), showing a most unusual disjunction in range.

Ecol. Lowland rain-forest, hillsides on granite, on granitic sand, low ridges with sandy soil, also sandy loam with lime, mostly below 200 m, rarely ascending to 1000 m. *Fl.* June, *fr.* April–Oct.

Vern. Sumatra: *sēsēham*, Pakanbaru, *mēnta-pung*, *mēntēpung*, Banka.

b. var. *grandifolia* NOOT. Leid. Bot. Ser. 1 (1975) 141.

Leaves c. 30 by 8 cm. Nerves 10–14 pairs.

Distr. *Malesia*: NE. Sumatra (Asahan), 2 collections. Flowers unknown.

16. *Symplocos cochinchinensis* (LOUR.) S. MOORE, J. Bot. 52 (1914) 148; GUILLAUMIN, Bull. Soc. Bot. Fr. 71 (1924) 277; Fl. Gén. I.–C. 3 (1933) 998; MERR. Comm. Lour. (1935) 304; HAND.-MAZZ. Beih. Bot. Centralbl. 62 B (1943) 32; H. L. LI, J. Wash. Ac. Sc. 43 (1953) 107; NOOT, Leid. Bot. Ser. 1 (1975) 141, with full synonymy. — *Dicalix cochinchinensis* LOUR. Fl. Coch. 1 (1790) 663, *excl. syn. Arbor rediviva* RUMPH. — **Fig. 12, 13.**

For the many synonyms see under the varieties.

Small shrub to large tree. *Leaves* very variable in all characters. *Inflorescence* usually a spike, rarely a raceme, but in *ssp. leptophylla* sometimes reduced to a fascicle in the axils of the leaves or beneath them, in *ssp. thwaitesii* sometimes a panicle of racemes. *Fruits* ampulliform to globose, in *ssp. leptophylla* and *ssp. thwaitesii* from globose to ellipsoid, ovoid or ampulliform, in *ssp. cochinchinensis* var. *imbricata* ovoid to ellipsoid. *Seed* and embryo curved.

Distr. Continental Asia (India, Burma, Thailand, Indo-China, China, Japan, Ryu Kyu Is., Hainan, Formosa), throughout *Malesia* to Australia (Queensland, New South Wales, Lord Howe I.), the Solomons, New Hebrides, and Fiji.

Notes. The oldest name for this species is *Myrtus laurinus* RETZ. 1786. However, its epithet

can not be used because of the heterotypic synonym *S. laurina* WALL. ex G. DON, 1837.

This is the most widely distributed and also most variable species of the genus. The two main forms of the western part of its distribution, '*cochinchinensis*' and '*laurina*', have usually been treated as different species, the main difference being hairy versus glabrous calyx lobes; in addition the bract and bracteoles in *cochinchinensis* form a cup appressed to and concealing the ovary while the calyx lobes often enlarge in fruit forming a conical beak. In *laurina* the cup formed by the bract and bracteoles is more platter-shaped, while the calyx lobes form a small crown on top of the fruit, but they can also be closed.

These two forms can be kept rather well apart in large parts of the range, but in other parts they keep less well separate and this results in a great variability, in part intergrading, which I have ascribed to hybridization, while it is possible that from these hybrid swarms new small local taxa may have evolved through environmental conditions, e.g. *var. sessifolia* and *var. imbricata*.

Towards the eastern end of the range, in New Guinea, Australia, and the Pacific Islands forms occur which often have no resemblance any more to the two main western forms, but in the intermediate area they are linked with them in a continuous variation, and thus break down any definable distinction between them.

In these eastern forms, which I assume are 'derived' during the former eastward extension of the range, some new tendencies have developed, in that seed and embryo are only curved at the base and are uncinately and that there is a tendency towards unisexuality of the flowers. Several New Guinean forms are further characterized by a condensed fascicle-like inflorescence, while the disk often becomes hairy.

Within the species 5 of the 9 pollen subtypes known from *subg. Hopea* are found. The pollen type is only constant for *ssp. laurina* and for *ssp. cochinchinensis* and its varieties *philippinensis* and *sessifolia*.

Instead of giving a lengthy discussion on the variability I have found it more convenient and clear to subdivide the species in formally named subspecies and varieties, although I am aware that it will not always be possible to name odd deviating or intermediary specimens.

KEY TO THE SUBSPECIES

1. Seeds and embryo twice curved. Inflorescence a basally branched spike, rarely a raceme. Flowers bisexual. Disk always glabrous. Fruit ampulliform (ovoid to ellipsoid in *ssp. cochinchinensis* *var. imbricata*).
2. Calyx lobes hairy (except on Mt Diëng in Central Java), often enlarged in fruit, forming a conical beak 1. *ssp. cochinchinensis*
2. Calyx lobes glabrous, often ciliate, not enlarged in fruit 2. *ssp. laurina*
1. Seeds and embryo once curved. Inflorescence a basally branched spike or raceme, or flowers solitary or in a fascicle. Flowers bisexual or functionally unisexual (or plant polygamous). Disk glabrous or hairy. Fruit ellipsoid to ovoid or ampulliform.

3. Seeds and embryo once curved. (Disk glabrous or rarely pilose.) Calyx lobes glabrous, often ciliate. Flowers bisexual . . . 3. *ssp. thwaitesii*
3. Seeds and embryo uncinately curved towards the base. (Disk glabrous to densely pilose.) Calyx lobes glabrous to densely hairy. Flowers functionally unisexual or polygamous (in male flowers the stigma is absent) 4. *ssp. leptophylla*

1. *ssp. cochinchinensis*.

For synonyms see under the varieties.

KEY TO THE VARIETIES

1. Leaves usually pubescent or tomentose beneath; nerves 10–14 pairs, much prominent beneath, strictly parallel to each other, nearly reaching the margin; petiole (2–)5–17(–35) mm.
a. *var. cochinchinensis*
1. Leaves glabrous; nerves 4–11 pairs, usually not strictly parallel to each other, anastomosing or meeting in an intramarginal vein at some distance of the margin.
b. *var. sessifolia*
2. Leaves 3–12 by 1½–6 cm, index 1½–3; nerves 4–8 pairs; petiole 0–3 mm. Fruit at most 7 mm long b. *var. sessifolia*
2. Leaves 6–18 by 1½–6½ cm, index 1½–4½; nerves 5–11 pairs; petiole 3–25 mm. Fruit at most 7 mm long c. *var. philippinensis*
2. Leaves 4–9 by 2½–5½ cm, index 1–2; nerves 5–7 pairs; petiole 4–7 mm. Fruit 10–12 mm long d. *var. imbricata*

a. *var. cochinchinensis*. — *Dicalyx cochinchinensis* LOUR. Fl. Coch. 1 (1790) 663, excl. syn. *Arbor rediiva* RUMPH. — *Dicalyx aluminosus* BL. Bijdr. (1826) 1117, p.p. — *Dicalyx javanicus* BL. l.c. 1117. — *S. ferruginea* ROXB. (Hort. Beng. 1814, 40; WALL. Cat. 1831, n. 4412, nomen) Fl. Ind. ed. Carey 2 (1832) 542; MIQ. Fl. Ind. Bat. 1, 2 (1859) 466; CLARKE, Fl. Br. Ind. 3 (1882) 574; K. & V. Bijdr. 7 (1900) 141; BRAND, Pfl. R. Heft 6 (1901) 40; K. & G. J. As. Soc. Beng. 74, ii (1906) 238; KOORD. Atlas 2 (1914) t. 384; RIDL. Fl. Mal. Pen. 2 (1923) 302. — *S. mollis* WALL. (Cat. 1831, n. 4433, nomen) ex G. DON, Gen. Syst. 4 (1837) 3. — *S. spicata* ROXB. *var. platystachya* G. DON, l.c. 2. — *S. polystachya* WALL. (Cat. 1831, n. 4428, nomen) ex DC. Prod. 8 (1844) 254; MOR. Syst. Verz. (1854) 43; ZOLL. Syst. Verz. 2 (1854) 136; MIQ. Fl. Ind. Bat. 1, 2 (1859) 465. — *S. verhuellii* JUNGH. & DE VR. Pl. Ind. Or. 3 (1845) 12; MIQ. Fl. Ind. Bat. 1, 2 (1859) 467. — *S. horsfieldiana* MIQ. Sum. (1861) 475. — *S. lachnobotrys* MIQ. l.c., incl. *var. glabrior* MIQ. — *S. javanica* KURZ, J. As. Soc. Beng. 40, ii (1871) 64; *ibid.* 46, ii (1877) 239, excl. syn. *S. rubiginosa*; MERR. Int. Rumph. (1917) 420; HEYNE, Nutt. Pl. (1927) 1263; BURK. Dict. (1935) 2114; BACK. & BAKH. f. Fl. Java 2 (1965) 205. — *Lodhra javanica* MIERS, J. Linn. Soc. Bot. 17 (1879) 302. — *Lodhra ferruginea* MIERS, l.c. 299. — *Lodhra polystachya* MIERS, l.c. 300. — *Lodhra verhuellii* MIERS, l.c. 302. — *S. ferruginea* ROXB. *var. polystachya* CLARKE, Fl. Br. Ind. 3 (1882) 575. — *Eugeniodes ferrugineum* O. K. Rev. Gen. Pl. 2 (1891) 975. — *Eugeniodes lachnobotryum* O. K. l.c. — *S. delectans* BRAND, Bot. Jahrb. 54 (1916) 219. — *S. ferruginea* ROXB. *var. delectans* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 487. — Fig. 7.

Shrub or small tree, 9–22 m by 30 cm \varnothing , rarely a large tree to 45 m by 80 cm \varnothing . Twigs rusty tomentose or velvety, glabrescent, rarely pubescent, appressedly pilose, or glabrous. *Leaves* rusty or brownish pubescent or tomentose beneath, especially on midrib and nerves, rarely glabrous, (ovate to) elliptic (to obovate) with cuneate, rarely rounded or (in New Guinea) cordate base, glandular dentate or crenulate margin and more or less acuminate apex, (6–)12–25 by (2 $\frac{1}{2}$ –)3–10 cm; nerves (8–)10–14(–16) pairs, very prominent beneath, parallel to each other, mostly quite straight, curved upwards towards the margin and nearly reaching it, whether forming an intramarginal vein or not; petiole (2–)5–17 mm (rarely to 35 mm in New Guinea). *Spike* usually branched, 3–15 cm, in *topodeme morobeensis* up to 3 cm, axis densely rusty tomentose or pubescent, in New Guinea sometimes sericeous. Bracts and bracteoles persistent, with same indument, the former at least 2 mm long and broad, but usually longer, exceptionally up to 10 mm long, with the 2 smaller bracteoles forming a calycle hiding the ovary. *Flowers* faintly scented to fragrant. *Calyx* appressedly pubescent (in *topodeme morobeensis* indument only towards the apex), divided into (1–)2(–3) mm long lobes. *Corolla* white (according to some collectors with a yellow spot on each lobe), from 2 (sometimes in New Guinea) to 3–5 mm long. *Stamens* 30–70 (in New Guinea from 10 at high altitudes to more than 70 at low altitudes). Disk glabrous. *Ovary* glabrous, $\frac{1}{2}$ –1 mm high; style glabrous, 3–5 mm. *Fruit* ampulliform or globose, 5–7 by 4–5 mm, more or less ribbed when dry, often narrowed into a cylindrical neck, crowned by the usually closed, enlarged, calyx lobes which form a conical beak on top. *Seed* 1, twice curved with similar curved embryo.

Distr. Continental SE. Asia (India, Burma, Thailand, Indo-China, China, Hainan, Formosa, Ryu Kyu Is., Japan) and throughout *Malesia* except the Lesser Sunda Is., Celebes, and the Moluccas, scarce in the Philippines.

Ecol. A variety of habitats over a considerable altitudinal range, from the lowland up to c. 2500 m, in New Guinea even to 3000 m, in the understorey of rain-forest, primary and secondary, in the hills often associated with *Eugenia* and *Fagaceae*, extending to a few exceptional conditions, e.g. in Banka and Billiton on granite sands. *Fl.* (Jan.–May) June–Sept. (Oct.–Dec.), *fr.* Oct.–July. Ripe fruit dark blue. In Malaya crown shape often called deep, domed, narrow and dense.

Vern. Sumatra: *digëra*, *këdung*, *këmbang lonah*, *Djambi*, *kayu njari badok*, Lampong, *kaju salondung*, *k. si hondung*, Padanglawas, *kekapat*, Pasemah, *loba-loba*, Batak, *madang harbo*, Tapanuli, *mënkëndung*, Banka, *sëkëndum*, *sëpandong*, Palembang; Java: *djirak*, *S. ki huüt*, Bantam; *kayu ara*, Kota Belud, *habo*, Sg. Baru, *kayu (h)abu*, Bandjar, Martapura; Philippines: *tabu*, Ifiogo; New Guinea: *kumën*, Wigote, Wapi lang., *kutomi*, Wandammen lang., *mirik*, Sepik, Waskuk lang.

Notes. *S. cochinchinensis* possesses rather constant characters in large parts of its area, especially in continental Asia. In Java glabrous leaves become rather common, towards East Java the number of nerves decreases, and the leaves begin to resemble those of *ssp. laurina*. Here we

find the gradual transition to *var. philippinensis*. The latter variety replaces *var. cochinchinensis* in the Lesser Sunda Is., Celebes, the Moluccas, and most of the Philippine islands.

A conspicuous population from the Morobe District, New Guinea, is named *topodeme morobeensis* (petioles 15–35 mm, inflorescence up to 3 cm, indument of calyx only towards the apex or on the margin).

b. *var. sessifolia* (BL.) NOOT. Leid. Bot. Ser. 1 (1975) 153. — *Dicalyx sessifolius* BL. Bijdr. (1826) 1118. — *Dicalyx salaccensis* BL. l.c. — *S. laurina* (non WALL.) MOR. Syst. Verz. (1845) 42. — *S. sub-sessilis* CHOISY (ex ZOLL. Syst. Verz. 2, 1854, 136, *nomen*) ex MIQ. Fl. Ind. Bat. 1, 2 (1859) 467. — *S. sessi(li)folia* GÜRKE in E. & P. Nat. Pfl. Fam. 4, 1 (1890) 170; BRAND, Pfl. R. Heft 6 (1901) 35; KOORD. Atlas 2 (1914) t. 388; BACK. & BAKH. f. Fl. Java 2 (1965) 205. — *Eugeniodes sessilifolius* O. K. Rev. Gen. Pl. 2 (1891) 409. — *Eugeniodes salaccense* O. K. l.c. — *Eugeniodes diengense* O. K. l.c. — *S. spicata* ROXB. f. *subsessilis* K. & V. Bijdr. 7 (1900) 146. — *S. cochinchinense ssp. sessifolia* NOOT. ex STEEN. Mt. Fl. Java (1972) pl. 52–4. — Fig. 7, 12, 13c–e.

Shrub 1–5 m to small tree, 10 m, 10 cm \varnothing . Twigs glabrous or nearly so. Innovations purple. Leaves glabrous, coriaceous, with cuneate-attenuate base and faintly acuminate apex, 3–12 by $1\frac{1}{2}$ –6 cm; nerves 4–8 pairs, meeting in a faint intramarginal vein; petiole 0–3(–5) mm. Spike often branched, up to 6 cm, often crowded towards the end of the twigs, axis densely appressedly pubescent; flowers purplish. Bracts, bracteoles and flowers as in *var. cochinchinensis*, but on Mt Diëng the calyx only ciliate, or only pubescent towards the margin. Calyx lobes on the fruit not enlarged and closed.

Distr. Malesia: West & Central Java (Mts Salak eastward to Sumbing).

Ecol. A constituent of the summit forest of the volcanic peaks, often associated with *Myrsine*, *Leptospermum*, *Eurya*, *Schima*, *Photinia*, and *Myrica*, on stony ridges and summits, able to invade exposed sterile rocky places in the vicinity of craters as a dwarf pioneer shrub, 1700–3050 m. *Fl.* mainly Oct.–Jan. (Febr.–March), *fr.* July–Aug.

For the ecology and flower biology see the general paragraphs under the genus. Fruit blue-black when ripe. Flush purple or blue-violet.

Uses. Flush is sometimes eaten as *lalab* (vegetable).

Vern. *Djirak*, *putat*, *S. djirak mëlowo*, *sasah*, *J.*

c. *var. philippinensis* (BRAND) NOOT. Leid. Bot. Ser. 1 (1975) 154. — *Dicalyx aluminosus* BL. Bijdr. (1826) 1117, p.p. — *S. spicata* (non ROXB.) F.-VILL. Nov. App. 4 (1880) 127. — *S. syringoides* BRAND, Pfl. R. Heft 6 (1901) 41; S. MOORE, J. Bot. 52 (1914) 148; MERR. Int. Rumph. (1917) 421. — *S. ferruginea* ROXB. *var. philippinensis* BRAND, Philip. J. Sc. 3 (1908) Bot. 6. — *S. ahernii* BRAND, l.c.; MERR. En Philip. 3 (1923) 297. — *S. ramosii* MERR. Philip. J. Sc. 12 (1917) Bot. 293; En. Philip. 3 (1923) 302. — *S. ferruginea* ROXB. *var. syringoides* HALL. f. Beih. Bot. Centralbl. 39 B (1923) 92. — *S. javanica* (non KURZ) MERR. En. Philip. 3 (1923) 299. — Fig. 7.



Fig. 12. *Symplocos cochinchinensis* (LOUR.) S. MOORE ssp. *cochinchinensis* var. *sessifolia* (BL.) NOOT. in fruit (and 1 flower), on summit of Mt Pangrango, West Java, at 3000 m (NOOTEBOOM 906). Photogr. NOOTEBOOM, Febr. 1969.

Tree to 25 m high, 50 cm Ø. Twigs glabrous or appressedly pubescent. Leaves glabrous, or the midrib sparsely appressedly fine-hairy, ± elliptic with cuneate base and acuminate apex, (4-)6-18 by 1½-6½ cm, but 5-13 by 2½-5½ cm in the Philippines; nerves 5-10(-15) pairs; petiole 3-15, in the Philippines 10-25 mm. Spike with tomentellous to pubescent axis. Bracts 1-2 mm, to 3 mm in the Lesser Sunda Is., with the bracteoles with same indument as the spike, further as in ssp. *laurina*. Calyx finely appressedly pubescent, divided into c. 1 mm long lobes. Corolla 3-6 mm. Stamens 35-70. Disk glabrous. Ovary glabrous, ½-1 mm high; style glabrous, 2-5 mm. Fruit as in ssp. *laurina*.

Distr. *Malesia*: Central & East Java, Lesser Sunda Is. (Bali, Sumbawa, Flores), Philippines (common, throughout), Celebes, Moluccas (Tidore, Ternate, Buru, Ambon, Ceram).

Ecol. In Java in mountain rain-forest, also in tjemara forest, 700-2600 m, in the Lesser Sunda Is. 500-2400 m, in the Philippines from low altitude up to 2000 m, also recorded from primary Dipterocarp forest, in the Moluccas from low altitude to 1400 m. Fl. (Jan.-June) July-Dec., fr. Jan.-Aug. Flowers said to be scented; fruit turning through red to blue.

Vern. Java: *kayu djurang*, *tjirug*, J; Philippines: *abuabu*, *chaniusiu*, *gudik*, Ig., *banatong-babae*, Tag., *tarañgisi*, Bag., *ngarau-ngarau*, Neg.; Moluccas: *bunga ajang*, Ambon.

Note. In East Java this variety has probably originated by hybridization between ssp. *laurina*

var. *laurina* and ssp. *cochinchinensis* var. *cochinchinensis*.

d. var. *imbricata* (BRAND) NOOT. Leid. Bot. Ser. 1 (1975) 155. — *S. imbricata* BRAND, Philip. J. Sc. 4 (1909) Bot. 109; *ibid.* 7 (1912) Bot. 31; MERR. En. Philip. 3 (1923) 299. — Fig. 7.

Shrub or tree, 8-10 m. Twigs glabrous. Leaves glabrous, more or less coriaceous, usually broadly ovate, with cordate or slightly acuminate base, glandular dentate margin, and acuminate apex, 4-9 by 2½-5½ cm; nerves 5-7 pairs. Spikes axillary or pseudoterminal. Bract and bracteoles persistent. Calyx more or less appressedly pubescent, divided into 2 mm long lobes. Corolla c. 6 mm. Stamens c. 60. Disk glabrous. Ovary glabrous, c. 1 mm high. Fruits black, ovoid to ellipsoid, 10-12 by c. 8 cm with smooth stone.

Distr. *Malesia*: Philippines (Luzon).

Ecol. In subalpine one-storey, mossy forest, 2000-2600 m. Fl. Dec.-April, fr. Aug.-Sept., Jan.-March. Innovations glossy redbrown, ripe fruit dark blue.

Note. This mountain form is probably directly derived from var. *philippinensis*, from which it differs in the shorter leaves and larger fruit.

2. ssp. *laurina* (RETZ.) NOOT. Leid. Bot. Ser. 1 (1876) 156. — *Myrtus laurinus* RETZ. Obs. Bot. 4 (1786) 26.

Note. This subspecies ranges from Ceylon eastwards to Celebes, China and Japan. Besides the type variety there is only one local stenophyllous variety in Indo-China and S. China.

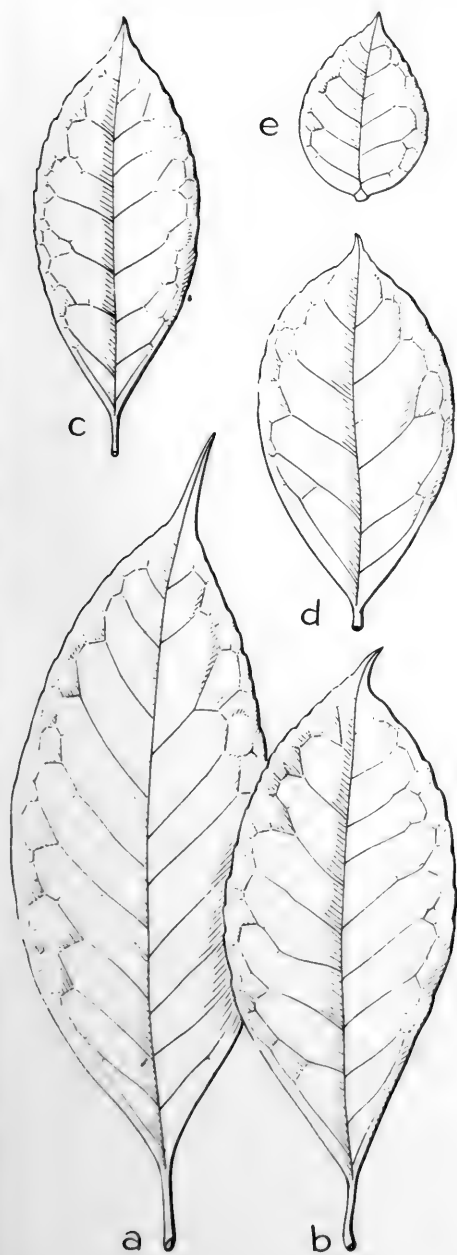


Fig. 13. Leaf size and shape in *Symplocos cochinchinensis* (LOUR.) S. MOORE at different altitudes, from a to e at 100, 1600, ?1800, 2000, and 3000 m respectively. a-b. *ssp. laurina* (RETZ.) NOOT. var. *laurina*, c-e. *ssp. cochinchinensis* var. *sessifolia* (BL.) NOOT., all $\times \frac{1}{3}$ (a LÜTJEHARMS 4561, b BLOKHUIS 7-12-21, c BLUME 1965, d Ja 4010, e DOCTERS VAN LEEUWEN 8425).

e. var. *laurina*. — *Laurus serrata floris spicatis* BURM. Thes. Zeyl. (1737) 139, t. 62. — *Myrtus laurinus* RETZ. Obs. Bot. 4 (1786) 26, non *S. laurina* WALL. ex G. DON, 1837. — *Drupatris cochinchinensis* LOUR. Fl. Coch. 1 (1790) 314. — *Decadia aluminosa* LOUR. l.c. 315. — *Eugenia laurina* WILLD. Sp. Pl. 2 (1799) 967, p.p. — *Dicalyx spicatus* BL. Bijdr. (1826) 1118. — *Dicalyx acuminatus* BL. l.c. 1119. — *S. spicata* ROXB. (Hort. Beng. 1814, 40; WALL. Cat. 1831, n. 4417, nomen) Fl. Ind. ed. Carey 2 (1832) 542; CHOISY in Zoll. Syst. Verz. 2 (1854) 136; MIQ. Fl. Ind. Bat. 1, 2 (1859) 465; CLARKE, Fl. Br. Ind. 3 (1882) 573, incl. var. *malasica* l.c. et var. *laurina* l.c. p.p.; K. & V. Bijdr. 7 (1900) 144, incl. f. *javanica* l.c. et f. *acuminata* et f. *xanthophylla* l.c. 145, excl. f. *subsessilis*; BRAND, Pfl. R. Heft 6 (1901) 39, incl. var. *acuminata* l.c. 41; K. & G. J. As. Soc. Beng. 74, ii (1906) 236; KOORD. Atlas 2 (1914) t. 386, 387; RIDL. Fl. Mal. Pen. 2 (1923) 301; S. MOORE, J. Bot. 63 (1925) Suppl. 65; HEYNE, Nutt. Pl. (1927) 1263; BURK. Dict. (1935) 2115; BACK. & BAKH. f. Fl. Java 2 (1965) 205. — *S. laurina* WALL. (Cat. 1831, n. 4416, nomen) ex G. DON, Gen. Syst. 4 (1837) 3; REHD. & WILS. in Sargent, Pl. Wils. 2 (1916) 594; REHD. J. Arn. Arb. 15 (1934) 298; MERR. Comm. Lour. (1935) 303; CORNER, Ways. Trees (1940) 623; HAND.-MAZZ. Beih. Bot. Centralbl. 62 B (1943) 33; STEEN. Fl. Mal. I, 5 (1957) clxxxi, f. 4. — *S. polycarpa* WALL. (Cat. 1831, n. 4423, nomen) ex G. DON, Gen. Syst. 4 (1837) 3; MIQ. Fl. Ind. Bat. 1, 2 (1859) 465. — *S. ribes* JUNGH. & DE VR. Pl. Ind. Or. 3 (1845) 11; MIQ. Fl. Ind. Bat. 1, 2 (1859) 468. — *S. acuminata* MIQ. l.c. 467. — *Lodhra ribes* MIERS, J. Linn. Soc. Bot. 17 (1879) 302. — *Lodhra xanthophylla* MIERS, l.c. — *S. flavida* MIQ. (Pl. Hohenacker n. 1053) ex CLARKE, Fl. Br. Ind. 3 (1882) 573, in syn. — *Eugeniodes ribes* O. K. Rev. Gen. Pl. 2 (1891) 976. — Fig. 7, 13a-b.

Shrub, 3 m, to tree, 6-14 m by 30 cm \varnothing . Twigs and leaves glabrous, except sometimes the very youngest parts. Leaves \pm elliptic with cuneate base and acuminate apex, $4\frac{1}{2}$ -21 by $(1\frac{1}{2}-) 2\frac{1}{2}$ -8 cm; nerves 6-9 pairs (but in forms transitional to var. *cochinchinensis* up to 13 pairs), not strictly parallel, anastomosing at some distance of the margin, often meeting in an intramarginal vein; petiole (5-)10-15(-20) mm (in transitional forms the leaves are like those of var. *cochinchinensis* except for the indument). Spike $1\frac{1}{2}$ -14 cm, axis glabrous to more or less appressedly puberulous or pubescent. Bracts and bracteoles persistent, at most 2 mm long and broad, but usually only 1 mm, only enveloping the base of the ovary. A short pedicel exceptionally present. Calyx glabrous or nearly so, divided into 1-2 mm long, often ciliate lobes, not elongating in fruit, whether or not closed after anthesis. Rest of flower and fruit as in var. *cochinchinensis*.

Distr. Continental Asia (India, Ceylon, Burma, Thailand, Indo-China, China, Hainan, Formosa, Japan); in Malesia: Sumatra (also Enggano I.), Malay Peninsula (rare), Java (very common), Borneo (rare), Celebes (rare).

Ecol. Substage tree in rain-forest, sometimes in coastal vegetation, near waterfall, in Malaya found also in sandy, tidal *gelam* (*Melaleuca*) forest, in continental Asia, Sumatra and Celebes from low

altitude to c. 2000 or 3000 m, in Java only above c. 1000 m. *Fl.* Sept.–April, *fr.* Febr.–Sept. Flowers are said to be slightly foetid to strongly smelling, opening early in the morning. Fruit turns black via blue.

Vern. Sumatra: *kayu djari manuk*, Batak, *dadak putih, diera*, Enggano; Java: *djirak, d. sasak, S, djirèk, J.*

3. *ssp. thwaitesii* (F.v.M.) NOOT. *Leid. Bot. Ser. 1* (1975) 159, with full synonymy. — *S. thwaitesii* F.v.M. *Fragm. 3* (1862) 22.

Distr. This subspecies consists of 4 varieties which occur in Queensland, New South Wales, and Lord Howe I. One of these is also found in New Guinea.

Note. There is one sheet (LAE 54751) which is not identified to a variety; it might belong to the Queensland *var. montana* (C. T. WHITE) NOOT.

f. *var. stawellii* (F.v.M.) NOOT. *Leid. Bot. Ser. 1* (1975) 161. — *S. stawellii* F.v.M. *Fragm. 5* (1865) 60; BRAND, *Pfl. R. Heft 6* (1901) 37, *excl. var.* — *S. spicata* ROXB. *var. australis* BTH. *Fl. Austr. 4* (1869) 292. — Fig. 7.

Tree up to 30 m high, 80 cm Ø. Twigs glabrous. Leaves glabrous, elliptic with broadly cuneate base and not or faintly acuminate apex, 6–16 by 2½–10 cm; nerves 8–11 pairs; petiole 5–25 mm. Spike often branched, rarely exceeding 6 cm, the axis glabrous or appressedly puberulous. Bracts and bracteoles usually persistent, 1–1½ and ½–1 mm long respectively. Calyx glabrous, divided into ¼–¾ mm long lobes. Corolla 3–5 mm. Stamens 25–50. Disk glabrous. Ovary glabrous, 1–1½ mm high; style glabrous. Fruit ellipsoid-ovoid, 5–7 mm.

Distr. Australia: Queensland, New South Wales, and Lord Howe I.; in *Malesia*: New Guinea (Papua).

Ecol. Two habitats are recorded, viz in the lowlands with influence of a dry season, on edge of savannah forest, and on the Oriomo R. in association with *Acacia*, and in the middle mountains at c. 2000–2300 m, in secondary forest, tall mixed rain-forest, and in Podocarp-dominated forest on peaty soil. *Fl.* June, Sept., *fr.* June–Oct. Flowers are recorded to be fragrant. Fruit develops from green via blue to purple-black.

Vern. New Guinea: *tuliper*, Poio, Enga lang., *kun'gum*, Yogoo, Enga lang., *truom*, Oriomo R., Kiunga lang.

4. *ssp. leptophylla* (BRAND) NOOT. *Leid. Bot. Ser. 1* (1975) 162. — *S. stawellii* F.v.M. *var. leptophylla* BRAND, *Pfl. R. Heft 6* (1901) 37. — *S. leptophylla* TURRILL, *J. Linn. Soc. Bot. 43* (1915) 30. — *S. mamberamo* BRAND, *Nova Guinea 14* (1924) 186.

For further synonyms see under the varieties.

Notes. This is a rather heterogeneous subspecies ranging from the Lesser Sunda Is. and Moluccas through New Guinea (incl. Bismarcks) to Melanesia (Solomons, New Hebrides) and W. Polynesia (Fiji), the type having been described from Fiji. The varieties are rather reticulately allied and are often connected by intermediate specimens among which may be some hybrids. Some collections I could not refer to a variety, in part due to inadequate material, e.g. the type of *S. mamberamo*.

In most varieties the flowers are functionally

unisexual or bisexual in the same variety. In the functionally female flowers the number of stamens is low, while the style is large, with peltate stigma. In the functionally male flowers the number of stamens is high and the style is small, without stigma.

KEY TO THE VARIETIES

1. Underside of leaves hairy.
2. Twigs glabrous g. *var. leptophylla*
2. Twigs hairy.
3. Calyx and ovary glabrous.
4. Disk hairy g. *var. leptophylla*
4. Disk glabrous. Twigs sericeous or tomentose s. *var. ovata*
3. Calyx and/or ovary hairy.
5. Ovary glabrous.
6. Disk glabrous. Twigs sericeous or tomentose s. *var. ovata*
6. Disk hairy.
7. Twigs (appressedly) pubescent. g. *var. leptophylla*
7. Twigs tomentose or pilose. v. *var. versteegii*
5. Ovary hairy.
8. Calyx glabrous.
9. Twigs sericeous or tomentose. s. *var. ovata*
9. Twigs (appressedly) pubescent. g. *var. leptophylla*
8. Calyx hairy.
10. Disk glabrous.
11. Bracts shorter than 3 mm, fruits to c. 10 mm long s. *var. ovata*
11. Bracts longer than 3 mm, fruits more than 10 mm long t. *var. revoluta*
10. Disk hairy.
12. Twigs (appressedly) pubescent. g. *var. leptophylla*
12. Twigs not appressedly pubescent or puberulous, e.g. tomentose.
13. Petiole more than 20. j. *var. tomentosa*
13. Petiole less than 20 mm.
14. Inflorescence a (basally branched) spike.
15. Bracts shorter than 3 mm o. *var. reginae*
15. Bracts longer than 3 mm t. *var. revoluta*
14. Inflorescence not a spike.
16. Nerves in 7–11 pairs. m. *var. molobros*
16. Nerves in 4–8 pairs. o. *var. reginae*
1. Underside of leaves glabrous.
17. Calyx and ovary glabrous.
18. Twigs hairy.
19. Petiole 0 to 5 mm.
20. Leaves shorter than 5 cm. r. *var. orbicularis*
20. Leaves longer than 5 cm. l. *var. longilobata*
19. Petiole more than 5 mm.
21. Leaves obovate, 10–25 cm. Petiole 10–40 mm. i. *var. insularis*
21. Leaves ovate or elliptic, 2½–23 cm. Petiole 5–25 mm.

- 22. Leaves ovate or elliptic, 2½–11 cm. Twigs sparsely appressedly pilose.
u. var. *sogeriensis*
- 22. Leaves ± elliptic, 5–23 cm. Twigs appressedly pubescent. g. var. *leptophylla*
- 18. Twigs glabrous.
- 23. Inflorescence a very slender, often branched spike (or raceme) of 2–10 cm.
- 24. Twigs (exceptionally) thick.
p. var. *schumanniana*
- 24. Twigs not (exceptionally) thick.
- 25. Intramarginal vein far from margin.
p. var. *schumanniana*
- 25. Intramarginal vein close to margin.
w. var. *maculata*
- 23. Inflorescence a fascicle or a (reduced) often branched, stout spike (or raceme).
- 26. Petiole 0 to 5 mm . . . r. var. *orbicularis*
- 26. Petiole more than 5 mm.
- 27. Bracts and bracteoles caducous. New Hebrides.
var. *aneityensis* (BRAND) NOOT.
- 27. Bracts persistent.
- 28. Reticulation fine, usually prominent on both under and upper surface.
u. var. *sogeriensis*
- 28. Reticulation fine or coarse, usually only prominent on the undersurface.
- 29. Leaves usually less than 5(–8) cm long.
h. var. *monticola*
- 29. Leaves usually more than 5 cm long.
- 30. Inflorescence axis glabrous.
q. var. *floresana*
- 30. Inflorescence axis hairy.
- 31. Leaves obovate . . . i. var. *insularis*
- 31. Leaves elliptic or circular.
g. var. *leptophylla*
- 17. Calyx and/or ovary hairy.
- 32. Petiole 0 to 5 mm . . . x. var. *parvifolia*
- 32. Petiole more than 5 mm.
- 33. Ovary glabrous.
- 34. Disk glabrous. Twigs glabrous. Reticulation fine, usually prominent on both under and upper surface, calyx lobes to c. ½ mm long u. var. *sogeriensis*
- 34. Disk hairy.
- 35. Leaves usually less than 5(–8) cm long.
h. var. *monticola*
- 35. Leaves usually more than 5 cm long.
- 36. Inflorescence axis glabrous.
k. var. *doormanensis*
- 36. Inflorescence axis hairy.
g. var. *leptophylla*
- 33. Ovary hairy.
- 37. Twigs hairy.
- 38. Calyx glabrous . . . g. var. *leptophylla*
- 38. Calyx hairy.
- 39. Calyx symmetrically cleft.
n. var. *pedicellata*
- 39. Calyx regular.
- 40. Leaves obovate . . . i. var. *insularis*
- 40. Leaves elliptic or circular.
g. var. *leptophylla*
- 37. Twigs glabrous.
- 41. Calyx glabrous . . . g. var. *leptophylla*
- 41. Calyx hairy.
- 42. Inflorescence a very slender, often branched spike (or raceme) of 2–10 cm.
p. var. *schumanniana*

- 42. Inflorescence a fascicle or a (reduced), often branched, stout spike (or raceme).
- 43. Calyx 2–4-lobed or symmetrically cleft, calyx lobes becoming longer by tearing n. var. *pedicellata*
- 43. Calyx regularly 5-lobed.
- 44. Leaves obovate . . . i. var. *insularis*
- 44. Leaves elliptic or circular.
g. var. *leptophylla*
- g. var. *leptophylla*. — *S. stawellii* F.v.M. var. *leptophylla* BRAND, Pfl. R. Heft 6 (1901) 37. — *S. leptophylla* TURRILL, J. Linn. Soc. Bot. 43 (1915) 30, incl. *f. compacta* TURRILL, l.c. 31. — *S. palmarum* BRAND, Bot. Jahrb. 54 (1916) 220. — *S. trifurceps* BRAND, Nova Guinea 14 (1924) 186. — *S. römeri* BRAND, l.c. — *S. aggregata* WHITE & FRANCIS, Proc. R. Soc. Queensl. 38 (1927) 256, t. 17. — *S. luteifolia* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 487. — *S. turrilliana* A. C. SMITH, J. Arn. Arb. 33 (1952) 111. — Fig. 7.
- Shrub 2–3 m to tree 20–28 m by 20–45 cm Ø. Twigs glabrous or pubescent. Leaves glabrous or pubescent to finely appressedly pilose beneath, ± elliptic, with cuneate to cordate base, entire to dentate margin and acuminate apex, 5–23 by 2–12 cm; nerves 6–12 pairs, meeting in an intramarginal vein; petiole 5–25 mm. Inflorescence a fascicle or a reduced, branched spike, sometimes a spike or raceme to 5 cm, axis appressedly puberulous to pubescent or sericeous. Bracts and bracteoles persistent, with same indument, 1–10 and 1–4 mm long respectively. Pedicels 0–2 mm. Flowers ♂, ♀, or ♀. Calyx ¾–3 mm, either entirely divided into the hairy or glabrous lobes or not. Corolla 2–5 mm. Stamens c. 10 to more than 100, in ♀ flowers less than 20. Disk softly hairy. Ovary glabrous or pubescent to sericeous, 1–2½ mm high; style glabrous or with few hairs towards the base, small, without stigma in functionally ♂ flowers, with peltate stigma in ♀ and ♀ flowers. Fruit glabrous or sparsely pubescent, sessile in a fascicle or infructescence up to 5 cm or even more, ovoid to ellipsoid or ampulliform, often globose, 6–15 by 4–9 mm.
- Distr. W. Polynesia (Fiji), Melanesia (Solomons and Santa Cruz Is.); in *Malasia*: Moluccas (Buru, Ambon, Ceram) and very common in New Guinea (incl. Jappen, Normanby, and Goodenough Is.) and the Bismarck Archipelago (New Britain, New Ireland).
- Ecol. Very variable, rare in the lowland, mostly from 900–3360 m (Mt Otto), in the lauro-fagaceous forest, transition of conifer-*Castanopsis-Nothofagus* forest to grassland, mossy forest on ridge tops, in forest relicts of *Quercus-Dacrydium* forest (Arfak), once noted as a dominant on upper ridges, in association with *Podocarpus pilgeri* in New Britain, and in *Casuarina* forest there. Fl. Jan.–Aug., fr. Jan.–Dec. Flowers said to be fragrant. Fruit dark blue to purple black when mature.
- Vern. New Guinea: *aibeh*, Minj, *arilth*, Nondugl, *kelekende*, Mt Ambua, *koka*, Telefomin, Nah lang., *guguma*, *konguma*, *kunguma*, Mt Hagen, Wankl lang., *lilicop*, Waria, *matala*, Mt Talawe, New Britain, *navako*, New Britain, *paiviediedie*, Tari, Huli lang., *pelwaddi*, Mt Ne, Habono, *pungali*, Wabag, *tulifar*, *ypap*, Enga lang., *toma*, Saidor, *utu-utu*, Cycloop Mt, Ormu lang., *wapi*, Sepik, Wagu lang.

h. var. monticola NOOT. Leid. Bot. Ser. 1 (1975) 166. — Fig. 7.

Shrub 2 m to tree to 16 m by 22 cm \varnothing . Twigs glabrous. Leaves glabrous, \pm elliptic, with cuneate base, entire or denticulate margin and acute or rounded apex, 2–8 by 1–3 cm; nerves 5–7 pairs, meeting in an intramarginal vein; petiole 4–10 mm. Spike to $1\frac{1}{2}$ cm long, axis glabrous or sparsely appressedly hairy. Bracts and bracteoles persistent, glabrous, 1–2 and $1\frac{1}{2}$ mm long respectively. Flowers functionally unisexual or bisexual as in *var. leptophylla*. Calyx appressedly pubescent or puberulous to glabrous, usually divided into $1\frac{1}{2}$ mm long, often purple-tinged lobes. Corolla $1\frac{1}{2}$ mm. Stamens 15–35. Disk hairy. Ovary glabrous, $1\frac{1}{2}$ mm high; style glabrous. Fruit ovoid to ellipsoid, 8–10 by 4–6 mm.

Distr. *Malesia*: East New Guinea.

Ecol. Substage tree in mossy forest and secondary forest with much climbing bamboo, 2700–3500 m. *Fl.* April–Sept., *fr.* July–Aug.

Vern. *Ped-ped*, Giluwe, Mendi lang.

i. var. insularis NOOT. Leid. Bot. Ser. 1 (1975) 167. — Fig. 7.

Tree up to 15 m by 25 cm \varnothing . Twigs glabrous or appressedly pubescent. Leaves glabrous, mostly broadly ovate with attenuate base and acuminate apex, 10–25 by $5\frac{1}{2}$ –15 cm; nerves 6–8 pairs; petiole 10–40 mm. Flowers not seen. Inflorescence a fascicle or spike to $5\frac{1}{2}$ cm long; fruit sparsely pubescent, ovoid to globose, 8–13 mm long.

Distr. *Malesia*: East New Guinea (Louisiades: Sudest, Rossel & Misima Is.).

Ecol. Substage of rain-forest, along stream-bank, also on a summit where dwarfed to $1\frac{1}{2}$ m tall shrub; from the lowland to 800 m. *Fr.* July–Oct. Ripe fruits black.

j. var. tomentosa NOOT. Leid. Bot. Ser. 1 (1975) 167.

Tree to 20 m. Twigs and midrib tomentose beneath. Leaves mostly obovate, pubescent beneath, with cuneate base and rather abruptly acuminate apex, 18–23 by 10–12 cm; nerves 8–9 pairs; petiole 2–3 cm. Fascicle in the axils of the leaves or often beneath them, including the broadly boat-shaped 5 mm long bracts, the 3 mm long bracteoles and the calyx appressedly pubescent. Flowers unisexual or bisexual as in *var. leptophylla*. Calyx divided into 1–2 mm long lobes. Corolla 4–6 mm. Stamens 25 to more than 100. Disk softly pilose. Ovary pubescent, 1–2 mm high. Fruit not seen.

Distr. *Malesia*: East New Guinea (Fergusson I.).

Ecol. Montane rain-forest dominated by oaks, in the substage, 700–900 m. *Fl.* June. Flowers said to be very fragrant rose-scented.

k. var. doormanensis (BRAND) NOOT. Leid. Bot. Ser. 1 (1975) 168. — *S. doormanensis* BRAND, Nova Guinea 14 (1924) 187. — *S. dalmannensis* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 487.

Shrub or small tree, $1\frac{1}{2}$ m. Twigs sparsely pilose to glabrous. Leaves glabrous, coriaceous, elliptic, with cuneate base, entire to glandular denticulate margin and not or faintly acuminate apex, 6–12 by $2\frac{1}{2}$ –6 cm; nerves 5–10 pairs; petiole 7–10 mm.

Fascicles in the axils of the leaves or on wood, including the 5 mm long broadly boat-shaped bracts and the 3–4 mm long bracteoles appressedly (long) pilose to pubescent; bracts and bracteoles persistent. Flowers unisexual or bisexual as in *var. leptophylla*. Calyx appressedly pilose to pubescent, 2–3 mm long, divided into the lobes. Corolla 4–5 mm. Stamens 30–50. Disk softly pilose. Ovary glabrous, $1\frac{1}{2}$ –2 mm high; style glabrous. Fruit (immature) ellipsoid.

Distr. *Malesia*: New Guinea.

Ecol. Montane rain-forest, also in mossy forest, 1800–2700 m. *Fl.* Jan., *fr.* Oct.–Nov.

l. var. longilobata NOOT. Leid. Bot. Ser. 1 (1975) 169. — Fig. 7.

Shrub or small tree, $\frac{1}{4}$ –8 m by 15 cm \varnothing . Twigs sparsely appressedly fine-pilose, glabrescent. Leaves glabrous, elliptic (to orbicular) with rounded to more often cuneate base, crenulate margin and acute (to rounded) apex, 10–23 by 6–14 mm; nerves 2–4 pairs; petiole 2–3 mm. Flowers unisexual or bisexual, solitary or c. 3 in a condensed spike to 1 cm, axis pubescent. Bracts and bracteoles persistent, 3–5–6 together, narrowly triangular, 3–5 mm long. Calyx glabrous, $2\frac{1}{2}$ – $4\frac{1}{2}$ mm long, the lobes (ovate to) triangular, ciliate, glandular, 2–4 mm. Corolla 3–4 mm. Stamens 14–24. Disk shortly pubescent. Ovary glabrous, 1–2 mm high, style glabrous, 2–4 mm. Fruits ovoid to ellipsoid, c. 10 by 6 mm, stone rather smooth.

Distr. *Malesia*: East New Guinea (Mt Wilhelm).

Ecol. Alpine shrubberies and forest edges, in subalpine tussock grassland, along creek in peaty grassland, a stiff, fastigate, microphyllous race, in sterile exposed places often dwarfed, 3200–3400 m. *Fl.* June–July, *fr.* July. Ripe fruit blue-black.

m. var. molobros (BRAND) NOOT. Leid. Bot. Ser. 1 (1975) 169. — *S. molobros* BRAND, Bot. Jahrb. 54 (1916) 217. — Fig. 7.

Small shrub $\frac{1}{2}$ – $1\frac{1}{4}$ m to slender tree, 4–6 m. Twigs densely (woolly) pilose. Leaves softly pilose beneath, (broadly) elliptic, with cuneate to rounded or even subcordate base, entire to glandular dentate margin and apex whether or not acuminate, 6–18 by $3\frac{1}{2}$ –8 cm; nerves 7–11 pairs, meeting in a looped intramarginal vein; petiole 5–10 mm. Inflorescence a much reduced, branched, spike or a fascicle in the axils of the leaves or on wood, up to 2 cm long; axis rusty patently sericeous-pilose. Bracts and bracteoles persistent, rusty long pilose to appressedly sericeous, 2–4 and 1–3 mm respectively. Calyx appressedly rusty sericeous or long pubescent, divided into 1–2 mm long lobes. Corolla $2\frac{1}{2}$ –5 mm. Stamens 20–60. Disk pilose. Ovary greyish sericeous, 1–2 mm high; style glabrous. Fruit ovoid to globose, 10–15 mm long, pubescent, becoming glabrous.

Distr. *Malesia*: New Guinea.

Ecol. Substage treelet in montane rain-forest, on sandy clay, on limestone or sandstone ridges, 700–2200 m. *Fl.* April–Nov., *fr.* Sept.

Vern. *Chandujant*, Wabag, Enga lang.

n. var. pedicellata NOOT. Leid. Bot. Ser. 1 (1975) 170. — Fig. 7.

Shrub 2– $4\frac{1}{2}$ m to slender tree 8–16 m. Twigs glabrous. Leaves glabrous, stiff, \pm elliptic, with

cuneate to rounded base and (abruptly) acuminate apex, 5–11 by $2\frac{1}{2}$ –6 cm; nerves 6–10 pairs; petiole 5–16 mm. Raceme up to 4 cm; axis sparsely appressedly puberulous as the persistent 1–2 mm long bracts and the 1–3 mm long pedicel. Calyx appressedly puberulous, c. 2 mm long, wholly symmetrically cleft. Corolla 3–4 mm. Stamens c. 40 in ♂ flowers, c. 10 in ♀ flowers. Disk softly pilose. Ovary appressedly puberulous, 2 mm high; style c. 3 mm, with conical pubescent base. Fruit ovoid to ampulliform, 10–15 by 7–9 mm. Seed strongly ruminate, embryo probably curved.

Distr. *Malesia*: East New Guinea.

Ecol. Substage of mossy forest and subalpine forest dominated by *Nothofagus-Weinmannia* or conifers (*Araucaria*, *Podocarpus*, *Papuacedrus*), sometimes abundant on ridges, also on limestone, 2100–2900 m. *Fl.* (Jan.) April–Oct., *fr.* June.

Vern. *Ypap*, Wabag, Enga lang., *keh*, *kepilam*, Enga lang.

o. var. reginae (BRAND) NOOT. Leid. Bot. Ser. 1 (1975) 171. — *S. reginae* BRAND, Bot. Jahrb. 54 (1916) 214. — Fig. 7.

Shrub 1–2 m to small tree to 10 m by 10 cm Ø. Twigs densely short and long pilose, only long-pilose, or woolly to tomentose; growth discontinuous. Leaves pubescent beneath, especially on the nerves, elliptic, with acuminate to rounded base, entire to glandular denticulate margin and acuminate apex, $1\frac{1}{2}$ –11 by $\frac{3}{4}$ – $6\frac{1}{2}$ cm; nerves 4–8 pairs; petiole 2–10 mm. Flowers solitary or few together in the axils of the leaves or below them, or on the apical part of an up to 3(–7) cm long spike; axis patently pilose. Bracts and bracteoles persistent, appressedly pilose, 2–4 mm and 1–2 mm respectively. Calyx appressedly pilose, divided into 1– $1\frac{1}{2}$ mm long lobes. Corolla 2–3 mm. Stamens 10–25. Disk pilose. Ovary appressedly pilose, $\frac{3}{4}$ –2 mm high; style glabrous or with pilose base. Fruit ovoid, pubescent, 9–15 by 7–8 mm. Seed 1–2, curved towards the base.

Distr. *Malesia*: New Guinea.

Ecol. Oak and beech forest, also on ridges, and in river gorge, 900–2000 m. *Fl.* June–Aug., *fr.* Jan.–Oct. Fruit from cream through purple to purplish-blue when ripe.

Vern. *Dorso*, Kassam Pass, Kainantu, *mongutl*, Hagen, *harkomerinkey*, Okapa, *mamele*, Morobe, Wagau.

p. var. schumanniana (BRAND) NOOT. Leid. Bot. Ser. 1 (1975) 171. — *S. rhynchocarpa* K. SCH. ex BRAND in K. SCH. & LAUT. Nachtr. (1905) 347; Bot. Jahrb. 54 (1916) 223. — *S. schumanniana* BRAND, l.c. 347 et 224. — *S. schlechteri* BRAND, l.c. 348 et 224. — *S. rupestris* BRAND, Bot. Jahrb. 54 (1916) 220. — *S. myrmecophila* SCHLTR ex BRAND, l.c. 224. — *S. pusilliflora* S. MOORE, Trans. Linn. Soc. II, Bot. 9 (1916) 107. — *S. cyclops* BRAND, Nova Guinea 14 (1924) 188. — *S. lamii* BRAND, l.c. — Fig. 7.

Shrub 2 m to tree 10–18 m by 12–37 cm Ø. Twigs sometimes very thick, glabrous, sometimes innovations appressedly pubescent, often the branches thickened in some places, hollow, lodging ants. Leaves ± elliptic, glabrous, with cuneate base, ± entire margin and acuminate apex, 9–33 by $3\frac{1}{2}$ –14 cm; nerves 8–15 pairs, meeting in intramar-

ginal vein far from the margin; petiole 5–22 mm. Inflorescence a slender spike (or rarely a raceme) to 6 cm, often branched towards the base, rarely for its whole length; axis pubescent or puberulous to glabrous. Bracts and bracteoles mostly persistent, rarely caducous, pubescent or puberulous, 1– $2\frac{1}{2}$ mm and $1\frac{1}{2}$ – $1\frac{1}{2}$ mm long respectively. Pedicel if present at most 1 mm. Calyx glabrous or puberulous, entirely divided into c. $\frac{1}{2}$ mm long lobes, or $1\frac{1}{2}$ mm long and then the lobes c. 1 mm. Corolla $1\frac{1}{2}$ –5 mm. Stamens 10–30 in ♀ and ♂ flowers, 30–80 in ♂ and ♀ flowers. Disk pilose. Ovary glabrous or puberulous, 1– $1\frac{1}{2}$ mm high; style glabrous or with some hairs towards the base. Fruit ampulliform, 5–6 by 3–4 mm, sometimes with rather long neck; stone ampulliform, rather smooth. Seed 1, curved, U-shaped with U-shaped embryo.

Distr. *Malesia*: Moluccas (Morotai), New Guinea, New Ireland, and New Britain.

Ecol. In high lowland rain-forest, sometimes with climbing bamboo, montane rain-forest on ridges, also on sandy clay, in *Nothofagus* dominated rain-forest on peaty soil, in New Britain also on limestone, from sea-level to 2100(–2820) m. *Fl.* Jan.–Dec., *fr.* July–Nov. Flowers are said to be faintly fragrant. Fruits turn from green through red to bluish when mature.

Vern. Moluccas: *reha*, Morotai; New Guinea: *pai*, Wandammen, *tembek*, Telefomin.

q. var. floresana NOOT. Leid. Bot. Ser. 1 (1975) 172. — Fig. 7.

Small, glabrous tree, up to 7 m by 15 cm Ø. Leaves (broadly) elliptic with cuneate to rounded base and not or slightly acuminate apex, 9–16 by 5–10 cm; nerves 7–12 pairs, meeting in an intramarginal vein; petiole stout, $2\frac{1}{2}$ – $4\frac{1}{2}$ cm. Spike basally branched, to 7 cm, axis glabrous. Bracts and bracteoles persistent, glabrous or appressedly pubescent, often ciliate. Calyx glabrous, divided into c. 1 mm long lobes. Corolla 3–4 mm. Stamens 25–35. Disk glabrous. Ovary glabrous, $\frac{1}{2}$ – $\frac{3}{4}$ mm high; style glabrous. Fruit c. ovoid, 5–6 by 4–5 mm.

Distr. *Malesia*: Lesser Sunda Is. (Flores).

Ecol. Montane rain-forest, 1000–1500 m. *Fl.* May–July, *fr.* April. Ripe fruit blue.

r. var. orbicularis (HEMSL.) NOOT. Leid. Bot. Ser. 1 (1975) 173. — *S. orbicularis* HEMSL. Kew Bull. (1899) 105. — *S. englishii* HEMSL. l.c. — *S. klossii* S. MOORE, Trans. Linn. Soc. II, Bot. 9 (1916) 108. — Fig. 7.

Stiff, often compact, microphyllous treelet, with densely foliated twigs and patent, brittle, thick (living ± fleshy) leaves; 20–50 cm to 3–10 m by 35 cm Ø. Twigs glabrous or hairy. Leaves glabrous, orbicular to elliptic, with cuneate to rounded or slightly cordate base, dentate to denticulate margin and rounded or acute apex, $\frac{1}{2}$ –3(– $3\frac{1}{2}$) by $\frac{1}{2}$ –2 cm; nerves 2–7 pairs; petiole 1–3 mm. Flowers solitary or in a spike to 4 cm; bracts 1–3 mm, several when flowers solitary, or 1. Bracteoles mostly persistent, glabrous or hairy, $\frac{1}{2}$ –3 mm long. Calyx glabrous, entirely divided into 1– $1\frac{1}{4}$ mm long lobes or a tube of $\frac{1}{2}$ –1 mm present. Corolla $2\frac{1}{2}$ –4(–6) mm. Stamens from less than 10 in ♀ flowers to 25 in ♂ and ♀ flowers. Disk glabrous. Ovary glabrous, ($\frac{1}{2}$ –)1–2 mm high. Fruit ellipsoid, 7–15 by 4–6 mm.

Distr. *Malesia*: New Guinea.

Ecol. Subalpine grassland shrubberies (often ericoid), sparse ridge top scrub, in moss-mounds in ridge thickets, associated with *Eurya*, *Dimorphanthera*, *Drimys*, on creviced faces and ridges of sandstone, also in subalpine moss forest, bank of a mountain torrent, still recorded as a tree of 10 m at 3300 m, 2500–3800 m, in Arfak as low as 1900 m. *Fl.* June–Aug., *fr.* June–Sept.

Vern. *Dibenkur*, Chimu, *pombor*, Giluwe, Mendi lang.

s. var. ovata NOOT. *Leid. Bot. Ser. 1* (1975) 173. — **Fig. 7.**

Shrub $\frac{3}{4}$ –4 m to tree 12–21 m by 15 cm \varnothing . Twigs appressedly sericeous to pubescent or tomentose, glabrescent, rarely glabrous. Leaves appressedly thin-hairy underneath, ovate to elliptic, with cuneate to cordate base and acuminate apex, 4–12 by 2–7 cm; nerves 5–10 pairs; petiole 5–20 mm. Spike basally branched, axis finely pubescent to tomentose. Bracts and bracteoles persistent, with same indument as axis or less hairy, 1–3 and 1–2 mm long respectively. Calyx glabrous but ciliate, or appressedly fine-hairy, divided into $\frac{1}{2}$ – $1\frac{1}{2}$ (–2) mm long lobes. Corolla 2–3 (–4) mm. Stamens 8–25. Disk glabrous. Ovary glabrous or sparsely appressedly fine-hairy, $1\frac{1}{2}$ – $2\frac{1}{2}$ mm high; style glabrous. Fruit ellipsoid to ovoid, 5–10 by 3–8 mm; stone ovoid, rather smooth. Seeds 1–2, ruminate, fitting into the grooves of the stone.

Distr. *Malesia*: East New Guinea, very common.

Ecol. Substage tree in tall mossy montane forest, in association with *Phyllocladus*, in alpine shrubberies, sometimes fire-induced, on margin of bog grasslands, 1900–3700 m. *Fl.* Jan.–Dec., *fr.* July–Jan. Flowers are said to have a slightly fetid fragrance.

Vern. *Bolbeh*, Chimu, Masul, *gongigl*, *miluad*, Chimu, *holai*, Asaro, Kefamo, *iamuga*, Minj, Togoba, *kumbag*, Togoba, *kungum*, Poio, Enga lang., *kunguma*, Goroka, Togoba, *ontkumanip*, Wahgi, Minj, *paawaedie*, Mt Ne, Huli lang., *paieriedie*, Margarima R., Huli lang., *pohn*, Hagen, Togoba, *uinyambangau*, Kubor, Minj, *wanepape*, Sirunki, *winjabunggawont*, Minj, *mara*, *ypap*, Wabag, Enga lang.

t. var. revoluta Noor. *Leid. Bot. Ser. 1* (1975) 174. — **Fig. 7.**

Shrub 1–3 m to tree 10 m. Twigs appressedly pubescent to villous or tomentose. Leaves appressedly sericeous to pubescent or tomentose beneath, especially on midrib and nerves, glabrescent, ovate to elliptic, with cuneate to cordate base, strongly revolute or recurved margin and rounded to acuminate apex, ($2\frac{1}{2}$ –)4–10 by (1–) $2\frac{1}{2}$ –6 cm; nerves (4–)7–10 pairs; petiole (2–)10–15 mm. Spike basally branched, to 3 cm, becoming much longer in fruit, axis densely pubescent to villous or tomentose; bracts often broadly boat-shaped, 3–4 mm. Bracteoles 2 mm, both persistent, appressedly long pubescent to villous. Calyx with same indument, (nearly) entirely divided into 1–2 mm long lobes. Corolla 2–4 (–5) mm. Stamens 10–60. Disk glabrous, with few hairs, or densely pilose. Ovary with same indument as calyx, 1–2 mm high. Style glabrous. Fruit ovoid to ellipsoid, 10–11 by 6–7 mm. Seed more or less curved towards the

base, embryo from nearly straight to U-shaped.

Distr. *Malesia*: New Guinea.

Ecol. Mossy forest, alpine shrubberies, on ridges and in valleys, constituent of subalpine forest of *Xanthomyrtus*, *Papuacedrus*, *Quintinia*, and *Ericaceae*, sometimes on peaty soil, 2200–3600 m. *Fl.* Febr.–Aug., *fr.* July–Dec. Ripe fruit purple blue.

Vern. *Bug-bakl*, Minj.

u. var. sogeriensis (BRAND) NOOT. *Leid. Bot. Ser. 1* (1975) 175. — *S. sogeriensis* BRAND, *Pfl. R.* Heft 6 (1901) 49. — *S. angiensis* KANEH. & HATUS. *Bot. Mag. Tokyo* 56 (1942) 485. — **Fig. 7.**

Shrub 2–5 m to tree 22 m by 25 cm \varnothing . Twigs glabrous (or appressedly pilose in innovations). Leaves glabrous, ovate or elliptic, with cuneate to rounded base, mostly crenate margin and rounded to faintly acuminate apex, $2\frac{1}{2}$ –11 by $1\frac{1}{2}$ –7 cm; nerves 5–9 pairs; petiole 5–20 mm. Spike basally branched to c. 3 cm, axis glabrous or appressedly pilose. Bracts and bracteoles persistent, glabrous or appressedly pilose, $\frac{1}{2}$ – $1\frac{1}{2}$ and $\frac{1}{2}$ –1 mm long respectively. Calyx glabrous, or lobes shortly pilose towards the apex, $\frac{1}{2}$ – $1\frac{1}{4}$ mm, lobes $\frac{1}{2}$ mm long. Corolla 2–3 mm. Stamens less than 10 in \varnothing flowers, to 30 in σ flowers. Disk glabrous (or with few hairs). Ovary glabrous, $\frac{1}{2}$ – $1\frac{1}{2}$ mm high; style glabrous. Fruit (ovoid to) ellipsoid, 5–9 by 3–5 mm; stone shallowly lengthwise or irregularly grooved.

Distr. *Malesia*: New Guinea.

Ecol. Montane to subalpine rain-forest and subalpine scrubbies, in stunted *Nothofagus-Myrtaceae* mossy forest, or forest dominated by *Castanopsis* or by *Podocarpus-Papuacedrus*, scattered in subalpine grasslands, on Mt Wilhelmina even at 3560 m in sheltered places still a constituent of 8–10 m high stunted forest; (1950–) 2100–3560 m. *Fl.* Sept.–April, *fr.* Jan.–Nov. Fruit turns bluish black when mature. Underside of leaves has sometimes globular, pea-sized galls.

v. var. versteegii (BRAND) NOOT. *Leid. Bot. Ser. 1* (1975) 176. — *S. versteegii* BRAND, *Nova Guinea* 14 (1924) 188.

Shrub or treelet to 5 m. Twigs densely tomentose or pilose. Leaves elliptic, except the tomentose or pilose midrib and nerves glabrous, or the whole surface covered by a cobweb-like or a long-pilose indument, base cuneate, apex not or slightly acuminate to mucronate-caudate, 10–16 by $4\frac{1}{2}$ –6 cm; nerves 6–14 pairs; petiole 6–18 mm. Fascicles in the axils of the upper leaves or on wood. Bracts and bracteoles persistent, appressedly long pubescent or sericeous, 4–5 and 2–3 mm long respectively. Calyx with same indument, divided into 2–3 mm long lobes. Corolla c. 5 mm. Stamens c. 50. Disk pilose. Ovary glabrous, 1–2 mm high; style glabrous. Fruit not seen.

Distr. *Malesia*: New Guinea.

Ecol. Rain-forest, 100 and 1300 m. *Fl.* Febr., June–July.

w. var. maculata (BRAND) NOOT. *Leid. Bot. Ser. 1* (1975) 176. — *S. maculata* BRAND in K.Sch. & Laut. *Nachr.* (1905) 348; *Bot. Jahrb.* 54 (1916) 222. — *S. margarita* BRAND, *Bot. Jahrb.* 54 (1916) 215. — *S. pisifera* BRAND, *l.c.* 216, *incl. var. miophylla* BRAND. — *S. ensicuspis* BRAND, *l.c.* 219.

— *S. arfakensis* GIBBS, Arfak (1917) 175. — *S. morobeensis* SLEUM. in Fedde, Rep. 42 (1937) 265. — Fig. 7.

Shrub 1–2 m to small or moderate tree up to 15 m by 25 cm Ø. Twigs glabrous. Leaves glabrous, ± elliptic with cuneate, decurrent base, mostly entire margin and acuminate apex, 2–13 by 1 $\frac{1}{4}$ –4 cm; nerves 4–10 pairs; petiole 3–15 mm. Spike very slender, often branched, 2–10 cm, axis pubescent or puberulous to glabrous. Bracts caducous or persistent, 1–1 $\frac{1}{4}$ mm long, with the c. $\frac{3}{4}$ mm long bracteoles pubescent or puberulous to glabrous. Calyx glabrous, divided into $\frac{1}{4}$ –1 mm long ciliate lobes. Corolla 2–4 mm. Stamens from less than 10 and sterile in ♀ flowers to 25 in ♂ flowers. Disk pilose. Ovary glabrous, $\frac{1}{2}$ –1 $\frac{1}{4}$ mm high; style glabrous. Fruit ovoid to ampulliform, 4–6 by 3–4 mm.

Distr. *Malesia*: New Guinea (incl. Sudest, Misima & Rossel Is.); common in New Guinea.

Ecol. Both in the lowland rain-forest at 150–300 m (Lousiades) as well as in montane rain-forest at 1600–2800 m, where associated with *Nothofagus*, *Araucaria* and *Castanopsis*, on narrow crests sometimes said to be abundant, also in secondary forests. Fl. Aug.–Jan. (June), fr. Aug.–Jan. Ripe fruit blue-black.

Vern. *Comogu*, Mendi, *kunguma*, Minj, Togoba, *mokgeh*, Hagen, Togoba lang., *ouksanok*, Telefomin.

x. var. *parvifolia* NOOT. Leid. Bot. Ser. 1 (1975) 177. — Fig. 7.

Shrub 1 $\frac{1}{2}$ –4 m to tree up to 10 m, often bushy and much-branched. Twigs (appressedly) pubescent or puberulous. Leaves glabrous, ± elliptic, with cuneate, attenuate base, denticulate or dentate margin and acute or acuminate apex, 1 $\frac{1}{4}$ –4 by $\frac{3}{4}$ –1 $\frac{3}{4}$ cm; nerves 5–7 pairs; petiole 2–4 mm. Spike small, few-flowered, to 1 cm, axis puberulous. Bracts and bracteoles persistent, puberulous, 1–2 and $\frac{1}{2}$ –1 mm long respectively. Calyx appressedly puberulous, divided into c. 1 mm long lobes. Corolla 2–2 $\frac{1}{2}$ mm. Stamens c. 10 in ♀ flowers to 25 in ♂ flowers. Disk densely soft hairy. Ovary glabrous or appressedly puberulous, 1–1 $\frac{1}{2}$ mm high; style glabrous or hairy towards the base. Fruit ovoid to ellipsoid, 7–10 by c. 4 mm.

Distr. *Malesia*: East New Guinea.

Ecol. Understorey treelet in lower montane to subalpine rain-forest dominated by *Nothofagus* and conifers (*Podocarpus* and *Papuacedrus*), often mossy, also on forest edges, 1850–3300 m. Fl. June–Oct., fr. Aug.

Uses. Flush is sometimes eaten as vegetable.

Vern. *Gili*, Ebenda, Mendi lang.

17. *Symplocos colombonensis* NOOT. Leid. Bot. Ser. 1 (1975) 177. — Fig. 7, 14a–c.

Small tree to 10 m. Twigs appressed-pubescent, dark brown. Leaves alternate, sparsely appressedly pilose beneath, especially on the margin, ovate, with cuneate to rounded base often revolute margin and acuminate apex, 4–9 by 1 $\frac{1}{2}$ –3 $\frac{1}{3}$ cm; nerves 7–11 pairs; petiole 3–4 mm. Raceme c. 3-flowered, to 3 cm long, axis finely appressedly pubescent. Bracts and bracteoles soon caducous, pubescent. Pedicel 1–5 mm. Calyx appressedly brown-pilose, 1 $\frac{3}{4}$ –3 mm, lobes triangular, 1 $\frac{1}{2}$ –2 $\frac{1}{2}$ mm. Corolla glabrous, or thinly red-hairy on the outside in bud, c. 5 mm. Stamens c. 90 or more. Disk glabrous or with some hairs. Ovary appressedly brown-pilose, 1 $\frac{1}{2}$ –2 mm high; style glabrous, 4–5 mm. Fruit (obliquely) ovoid to ellipsoid, 10–14 by 6 mm; stone except the apical 2–3 mm brain-like grooved. Seed not seen, but embryo probably straight.

Distr. *Malesia*: Borneo (Mt Kinabalu).

Ecol. Mountain forest, 2100–2800 m. Fl. Febr.–March, June–July, fr. July, Dec.

Note. Resembles *S. zizyphoides*, but a tree with less zigzag twigs, larger leaves with longer acuminate apex, and with calyx lobes longer in proportion to the tube.

18. *Symplocos composiracemosa* NOOT. Leid. Bot. Ser. 1 (1975) 178.

Twigs glabrous. Leaves glabrous, elliptic, with cuneate, acute base, entire or slightly undulate margin and acuminate apex, 8–13 $\frac{1}{2}$ by 2 $\frac{1}{2}$ –7 cm; nerves 5–9 pairs, meeting in a looped intramarginal vein; petiole 13–15 mm. Raceme compound, to 5 cm; axis sparsely minutely pilose. Bracts and bracteoles persistent, with same indument, 1 and $\frac{1}{2}$ mm long respectively. Pedicels at most 1 mm. Calyx glabrous, divided into the rounded, semi-

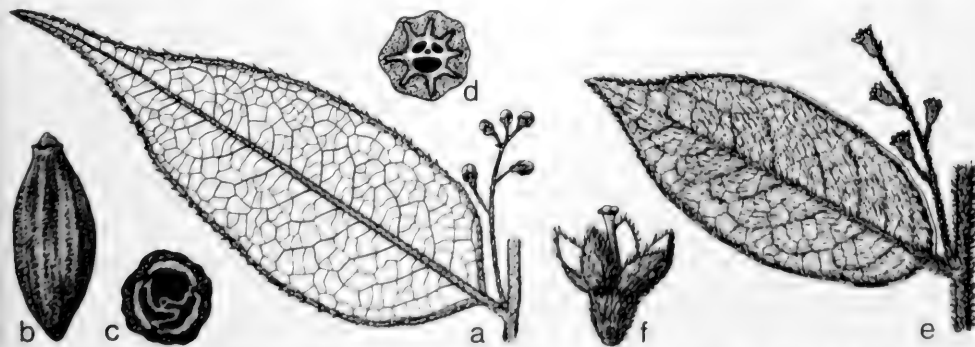


Fig. 14. *Symplocos colombonensis* NOOT. a. Habit, nat. size, b. fruit, c. CS of fruit, both $\times 3$. — *S. costata* (BL.) CHOISY. d. CS of fruit, nat. size. — *S. deflexa* STAFF. e. Habit, nat. size, f. deformed flower, $\times 4$ (a–c CLEMENS 33706, d KOORDERS 10996, e–f NOOTBOOM 1489).

elliptic, recurved, $1\frac{1}{2}$ –1 mm long lobes. *Corolla* c. 2 mm. *Stamens* 15–25, rather stiff. Disk glabrous. *Ovary* glabrous, c. 1 mm high; style glabrous, 1 mm. Immature fruit elliptic.

Distr. *Malesia*: East New Guinea (Morobe Distr.).

Ecol. Slender substage tree, 1300–1800 m, once mentioned in understorey of *Nothofagus* dominated ridge. *Fl.* Aug., Nov.

19. *Symplocos costata* (BL.) CHOISY in Zoll. Syst. Verz. 2 (1854) 136; MIQ. Fl. Ind. Bat. 1, 2 (1859) 467; K. & V. Bijdr. 7 (1900) 153; BRAND, Pfl. R. Heft 6 (1901) 52; KOORD. Atlas 2 (1914) t. 380; BACK. & BAKH. f. Fl. Java 2 (1965) 206; NOOT. Leid. Bot. Ser. 1 (1975) 179, pl. 8a–d, phot. 1–2. — *Dicalyx costatus* BL. Bijdr. (1826) 1117. — *S. cerasifolia* (non WALL. ex DC.) CHOISY in Zoll. Syst. Verz. 2 (1854) 136; MIQ. Fl. Ind. Bat. 1, 2 (1859) 466, *pro stirp.* Zoll. — *S. caryophylloides* ZOLL. (Syst. Verz. 2, 1854, 136, *nomen*) Nat. Tijds. N. I. 14 (1857) 161; MIQ. Fl. Ind. Bat. 1, 2 (1859) 467. — *Eugeniodes costatum* O. K. Rev. Gen. Pl. 2 (1891) 975. — *S. arcuata* BRAND, Pfl. R. Heft 6 (1901) 58. — *S. sericea* BRAND, l.c. 58; Bull. Herb. Boiss. II, 6 (1906) 748. — **Fig. 7, 14d, 15, 16.**

Tree to 20 m, 40 cm \varnothing . Twigs glabrous, often with cushion-shaped conspicuous leaf-scars, terminal buds with many scales, 5–10 mm long. *Leaves* glabrous, narrowly ovate to elliptic, with cuneate, acute base, slightly dentate, nearly entire

margin and acuminate apex, 6–21 by 2–7 cm; nerves (8–)10–13(–14) pairs; petiole 10–25 mm. *Spike* from the axils of the leaves or on wood, in bud resembling a cone like in *S. barringtoniifolia*, becoming at most 4 cm long, axis tomentose to pubescent. Bracts and bracteoles densely sericeous to pubescent, broadly boat-shaped, 5–8 mm long, soon caducous, and 2–3 mm long, later caducous respectively. *Calyx* glabrous, entirely divided into (narrowly) ovate to triangular, $2\frac{1}{2}$ –3 mm long lobes. *Corolla* 3–5 mm. *Stamens* 60 to more than 100. Disk shortly pilose. *Ovary* glabrous, c. $\frac{1}{2}$ mm high; style glabrous except sometimes the very base, 3–6 mm long. *Fruit* ellipsoid to cylindrical, often slightly curved, azure blue, 20–40 by 8–20 mm; mesocarp thick, corky, stone with c. 8 high ridges, 3-celled with a central canal, often only 1 cell developed. *Seed* cylindrical; embryo straight.

Distr. *Malesia*: West & Central Java (E as far as G. Telemojo). Fig. 17.

Ecol. High mountain forest, 900–2000 m, scattered. *Fl.* Aug.–Nov., *fr.* Aug.–March.

Vern. *Ki glèdog* (Tjibodas), *ki tëlör*, *ki tomkil*, *S.*

20. *Symplocos crassipes* CLARKE, Fl. Br. Ind. 3 (1882) 580; BRAND, Pfl. R. Heft 6 (1901) 52; K. & G. J. As. Soc. Beng. 74, ii (1906) 245; RIDL. Fl. Mal. Pen. 2 (1923) 305; NOOT. Leid. Bot. Ser. 1 (1975) 180, pl. 9–10.

For synonyms see under the varieties.

Shrub or small tree to 18 m. Twigs glabrous, or

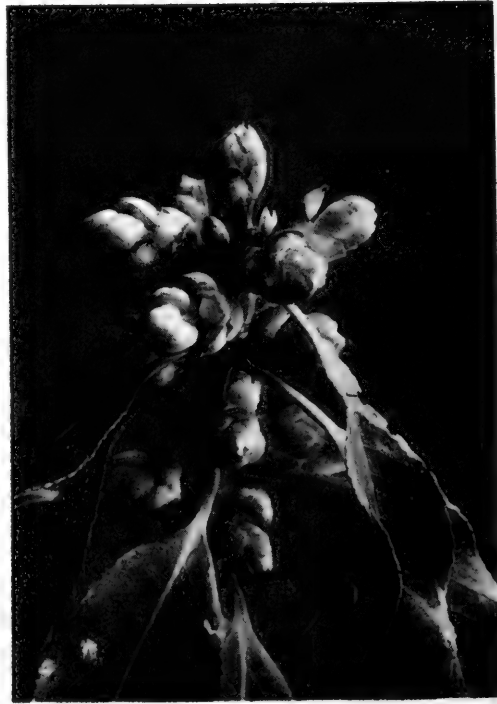


Fig. 15. *Symplocos costata* (BL.) CHOISY. Left a tree at Tjibodas Botanic Garden, West Java, 1450 m; right a twig in bud (NOOTEBOOM 885). Photogr. NOOTEBOOM, Febr. 1969.



Fig. 16. *Symplocos costata* (BL.) CHOISY. Close-up of flowers in anthesis (NOOTEBOOM 885). Photogr. NOOTEBOOM, Febr. 1969.

(obliquely) pubescent to appressedly or spreadingly long-hairy, sometimes with a double indument of a short tomentum and long spreading hairs. *Leaves* (narrowly) elliptic to ovate, beneath sparsely appressedly pilose, nearly glabrous, to densely appressedly to spreadingly long-hairy, rarely also hairy above, with cordate to cuneate base, recurved, entire to glandular denticulate margin and acuminate apex, 6–27 by $1\frac{1}{4}$ – $8\frac{1}{2}$ cm; nerves 3–11 pairs; petiole 1–10 mm. *Spike* short, often clustered, to 1(–2) cm, from the axils of the upper leaves, rarely flowers solitary, axis subglabrous to appressedly pubescent, or with long, spreading to appressed, stiff, brown to rusty hairs 1–4 mm long. Bracts and bracteoles persistent, (broadly) ovate, triangular or semi-elliptic, rarely acuminate, hairy. *Calyx* hairy or glabrous, whether or not entirely divided into the lobes. *Corolla* $2\frac{1}{2}$ –6 mm. *Stamens* c. 30 to c. 100. Disk glabrous. *Ovary* hairy, 1–2 mm high; style glabrous, but often with conical, hairy base. *Fruits* mostly 1–2 from each inflorescence, glabrous or sparsely long-hairy, bright blue in vivo, cylindrical, narrowed towards the apex, 13–18 by 3–5 mm; stone with c. 12 lengthwise grooves; cells 1–3. *Seed* usually 1, straight with straight embryo.

Distr. Continental Asia (Peninsular Thailand), in *Malesia*: Malay Peninsula (incl. Penang) and Borneo.

KEY TO THE VARIETIES

1. Leaves ovate, to 6 cm long and $2\frac{3}{4}$ cm wide; nerves 3–6 pairs. Flowers solitary.

e. *var. havilandii*

1. Leaves (narrowly) ovate to elliptic, $5\frac{1}{2}$ –27 by 2– $8\frac{1}{2}$ cm; nerves 3–11 pairs.

2. Leaf-base cordate, base angle 90–180°.

3. Leaves $5\frac{1}{2}$ –14 cm long. Petiole 1–2 mm

b. *var. brandiana*

3. Leaves 16–18 cm long. Petiole c. 5 mm.

a. *var. crassipes*

2. Leaf-base not cordate. Base angle 25–90°.

4. Leaves sparsely appressedly pilose beneath, but the indument inconspicuous and leaves seemingly glabrous.

5. Twigs glabrous, rarely appressed-pubescent. Calyx often glabrous or nearly so, rarely appressed-pubescent. Style-base glabrous, rarely pilose c. *var. curtisii*

5. Twigs appressed-long-hairy, rarely glabrous. Calyx appressed-pubescent. Style-base pilose.

d. *var. ernae*

4. Leaves densely appressed-hairy to sparsely more or less appressed-long-hairy beneath, indument always evident.

6. Twigs densely patently brown hairy (hairs often c. 2 mm). Leaves sparsely (appressedly) long-hairy beneath. Nerves 6–11 pairs.

f. *var. penangiana*

6. Twigs densely obliquely pubescent. Leaves densely appressed-pilose beneath. Nerves 4–6 pairs g. *var. rufomarginata*

a. *var. crassipes*.

Twigs sparsely appressedly long-hairy. Leaves sparsely appressed-pilose beneath, the hairs inconspicuous, elliptic, with cordate base and acuminate apex, 16–18 by 6–8 cm; nerves c. 10 pairs; petiole much swollen, 5 mm. Inflorescence and flowers as in *var. brandiana* (sec. CLARKE).

Distr. Malesia: Malay Peninsula (Johore), only known from the type.

b. *var. brandiana* (K. & G.) NOOT. Leid. Bot. Ser. I (1975) 182. — *S. brandiana* KING & GAMBLE, J. As. Soc. Beng. 74, ii (1906) 245.

Small tree, 3–8 m. Twigs patently dark brown pubescent to tomentose and long-hairy. Leaves (appressedly) long-hairy beneath, but midrib and nerves patently hairy, with cordate base, $5\frac{1}{2}$ –14 by $1\frac{3}{4}$ –5 cm; nerves 6–10 pairs; petiole 1–2 mm. Spike often on a reduced twig with many cataphylls. Bracts and bracteoles narrowly ovate, appressedly long-hairy, 3–8 mm. Calyx divided into ovate, acuminate, appressedly brown hairy, $2\frac{1}{2}$ –3 mm long lobes. Stamens 60 or more. Style with hairy conical base, 4 mm. Fruit hairy.

Distr. Malesia: Malay Peninsula.

Ecol. Mixed forests, 100–1500 m.

c. *var. curtisii* (OLIV.) NOOT. Leid. Bot. Ser. I (1975) 183, pl. 9b–c. — *S. curtisii* OLIV. in Hook. Ic. Pl. 18 (1888) t. 1757. — *S. monticola* KING & GAMBLE, J. As. Soc. Beng. 74, ii (1906) 235; RIDL. Fl. Mal. Pen. 2 (1923) 301. — Fig. 7.

Treelet or shrub to 10 m, 35 cm \varnothing . Twigs glabrous or rarely appressed-pubescent. Leaves usually sparsely appressedly pilose, nearly glabrous beneath, with cuneate, slightly attenuate base, $8\frac{1}{2}$ –18 by 3– $8\frac{1}{2}$ cm; nerves 4–9 pairs; petiole 3–7 mm. Spike contracted, often branched, axis glabrous to appressedly pubescent. Bracts and bracteoles ovate to triangular, appressedly pubescent, 1– $1\frac{1}{2}$ and c. 1 mm long respectively. Calyx

glabrous or nearly so, rarely appressedly pubescent, $1\frac{1}{2}$ –2 mm, the lobes $\frac{1}{2}$ – $1\frac{1}{2}$ mm, becoming longer by tearing apart when older. Corolla $3\frac{1}{2}$ –4 mm. Disk glabrous. Ovary appressedly pubescent, often narrowly funnel-shaped, $1\frac{1}{2}$ –2 mm high; style glabrous, the base glabrous or pilose. Fruit glabrous, deep blue.

Distr. Continental Asia (Peninsular Thailand), in *Malesia*: Malay Peninsula (Johore, Selangor).

Ecol. Hill rain-forest, 200–1400 m. *Fl.* Aug.–Jan., *fr.* Febr.–May, Oct., flowers scented.

Vern. Malaya: *kayu jenerku*, Selangor: Temuan.

d. var. *ernae* (BRAND) NOOT. *Leid. Bot. Ser. 1* (1975) 184, pl. 10b. — *S. ernae* BRAND, *Pfl. R.* Heft 6 (1901) 58; MERR. *En. Born.* (1921) 486. — **Fig. 7.**

Shrub or slender tree to 18 m, 15 cm \varnothing . Twigs appressedly (long-)hairy, rarely glabrous. Leaves sparsely appressedly pilose, nearly glabrous beneath, with cuneate base, 6–15(–18) by $2\frac{1}{2}$ –6 (–7) cm; nerves 3–6 pairs; petiole 3–5 mm. Spike basally branched, contracted, axis appressedly pubescent. Bracts and bracteoles broadly ovate, often boat-shaped, appressedly pubescent, c. 1 mm long. Calyx appressedly pubescent, $1\frac{1}{4}$ –2 mm long, lobes 1 – $1\frac{1}{2}$ mm, often becoming longer in older stage. Corolla 3–5 mm. Stamens c. 30 to c. 70. Disk glabrous. Ovary appressedly pubescent, 1 – $1\frac{1}{2}$ mm high; style glabrous. Fruit glabrous.

Distr. *Malesia*: Borneo (Sarawak, Brunei, Sabah; also in W. Kutei: G. Kemul).

Ecol. Lowland mixed Dipterocarp forest, also in a swamp forest, and in hill rain-forest on sandy clay, from sea-level to 1500 m. *Fl.* Sept.–Oct., Febr.–June, *fr.* July, Nov.

e. var. *havilandii* (BRAND) NOOT. *Leid. Bot. Ser. 1* (1975) 184, pl. 10c. — *S. havilandii* BRAND, *Pfl. R.* Heft 6 (1901) 41; MERR. *En. Born.* (1921) 486.

Treelet. Twigs pubescent. Leaves ovate, rather densely appressed-pilose, especially on midrib and nerves and along the margin, with rounded base, $2\frac{3}{4}$ –6 by $1\frac{1}{4}$ – $2\frac{3}{4}$ cm; nerves 3–6 pairs; petiole 2–3 mm. Flowers solitary, sessile from the axils of the leaves. Bracts and bracteoles appressedly (long-) pubescent, semi-orbicular 2 mm long and ovate $1\frac{1}{2}$ mm long respectively. Calyx appressedly pubescent, 2 mm, the lobes $1\frac{1}{2}$ mm long. Corolla $2\frac{1}{2}$ mm. Stamens c. 35. Disk glabrous. Ovary appressedly pubescent, c. 1 mm high; style with pilose base. Fruit pale blue.

Distr. *Malesia*: Borneo (Sarawak).

Ecol. Hill rain-forest, 600–900 m. *Fl.* *fr.* July.

f. var. *penangiana* (K. & G.) NOOT. *Leid. Bot. Ser. 1* (1975) 185, pl. 9d. — *S. penangiana* KING & GAMBLE, *J. As. Soc. Beng.* 74, ii (1906) 245; RIDL. *Fl. Mal. Pen.* 2 (1923) 306. — **Fig. 7.**

Shrub or treelet to 10 m. Twigs glabrous patently dark brown hairy. Leaves narrowly elliptic, sparsely (appressedly) long-hairy beneath, especially on midrib and nerves, rarely also long-hairy above, with rounded to acute base, 6–27 by $2\frac{1}{2}$ –8 cm, margin often sharply glandular dentate, appressedly long-hairy beneath; nerves 6–11 pairs; petiole 2–10 mm. Spike contracted, branched, axis densely more or less appressedly villous, hairs 1–4 mm. Bracts and bracteoles appressedly dark

brown long-hairy, narrowly elliptic to ovate, sometimes caudate, 1–7 mm. Calyx densely appressedly dark brown hairy, entirely divided into $1\frac{1}{2}$ –4 mm long lobes. Corolla 3–6 mm. Stamens 30 to more than 100. Disk pilose. Ovary with same indument as calyx, 1 – $1\frac{1}{2}$ mm high; style with pilose base. Fruits hairy, pink.

Distr. *Malesia*: Malay Peninsula (incl. Penang).

Ecol. Lowland rain-forest, 150–500 m. *Fl.* May, *fr.* Nov., April.

g. var. *rufomarginata* NOOT. *Leid. Bot. Ser. 1* (1975) 185, pl. 10a.

Shrub or treelet to 5 m. Twigs densely pubescent. Leaves rather densely appressedly hairy beneath, ovate to elliptic, with cuneate base and margin densely appressedly rufous-hairy beneath, $5\frac{1}{2}$ – $11\frac{1}{2}$ by 2 – $3\frac{1}{2}$ cm; nerves 4–6 pairs; petiole 2–3 mm. Spike much contracted, axis hairy. Bracts and bracteoles (broadly) elliptic, c. 3 mm. Calyx densely, appressedly long sericeously pubescent, entirely divided into 2 mm long rounded lobes. Corolla c. $2\frac{1}{2}$ mm. Stamens c. 25. Disk glabrous. Ovary with same indument as calyx, c. 1 mm high; style hairy halfway up.

Distr. *Malesia*: Borneo (Sarawak, near Kuching).

21. *Symplocos cylindracea* NOOT. *Leid. Bot. Ser. 1* (1975) 187. — **Fig. 7.**

Tree 10–30 m, 35 cm \varnothing . Twigs glabrous, or pubescent in innovation. Leaves glabrous, or midrib (and nerves) minutely hairy beneath, \pm elliptic, acuminate with acute to rounded, attenuate base and crenate or crenulate margin, 9–15 by $3\frac{1}{2}$ – $9\frac{1}{2}$ cm; nerves 6–9 pairs, meeting in a looped intramarginal vein; petiole 7–20 mm. Flowers in an up to 8 cm long panicle with minute or shortly pilose axis. Bracts and bracteoles caducous, glabrous or minutely hairy, ciliate, ovate, c. 3 and c. 2 mm long respectively. Pedicel $\frac{1}{2}$ –3 mm, sometimes seemingly much longer when only one flower is left on a small branch. Calyx 2– $3\frac{1}{2}$ mm long, entirely divided into elliptic to nearly semi-orbicular lobes, sparsely appressedly pilose to glabrous, ciliate. Corolla 5–6 mm. Stamens more than 100. Disk 5-glandular, pilose except the glands. Ovary glabrous or pubescent, 1 – $1\frac{1}{2}$ mm high; style (minutely) pilose, 2–4 mm. Fruit cylindrical, 15 by 5–6 mm, mesocarp fleshy, stone with low lengthwise ridges, 3-celled, 1, 2, or all 3 cells developed. Seed 1 in each fertile cell, straight with straight embryo.

Distr. *Malesia*: New Guinea (West and North, Morobe Distr., Central Div., and New Britain).

Ecol. Plain rain-forest, also in *Anisoptera* forest on ridge top, 60–800 m. *Fl.* Jan.–July, *fr.* Febr.–March.

22. *Symplocos deflexa* STAFF. *Trans. Linn. Soc. 4* (1894) 205; BRAND, *Pfl. R.* Heft 6 (1901) 64; GIBBS, *J. Linn. Soc. Bot.* 42 (1914) 109; MERR. *En. Born.* (1921) 487; NOOT. *Leid. Bot. Ser. 1* (1975) 188. — **Fig. 7, 14e–f.**

Treelet to 6 m high and 8 cm \varnothing . Twigs obliquely-patently brown hairy, \pm zigzag. Leaves alternate, glabrous above, rather densely pilose beneath, especially towards the margin, elliptic, acuminate, obtuse or acute, with rounded or sharply attenuate

base and recurved to revolute, sharply glandular dentate margin, 3–5 by $1\frac{1}{2}$ – $2\frac{1}{2}$ cm; nerves 5–7 pairs, usually merging into the reticulation; petiole 1–2 mm, densely patently brown hairy. *Flowers* fragrant, in an up to 6-flowered, 1–4 cm long lax raceme which is appressedly to patently brown pilose in all parts except the corolla. Bracts and bracteoles persistent, c. 5 by 3 and c. 3 by $1\frac{1}{2}$ mm respectively. Pedicel 2–4 mm. *Calyx* divided into obtuse and semi-elliptic to acute and triangular lobes, c. $1\frac{1}{2}$ mm long. *Petals* 5–7, glabrous or the outer ones minutely appressedly hairy, 4–6 mm long. *Stamens* 60–90. Disk low, 5-glandular, sparsely long-pilose. *Ovary* $1\frac{1}{2}$ –2 mm high; style c. 5 mm, gradually thickened towards its base, the lower half sparsely long-pilose. *Fruit* ovoid, often curved, including the persistent calyx c. 10 by 5 mm; stone c. 8 by 4 mm with shallow grooves and large apical pore. *Seed* straight with straight embryo.

Distr. *Malesia*: Borneo (Sabah, only found on Mt Kinabalu near Paka cave).

Ecol. Low subalpine forest and mountain scrub, 2400–3200 m. *Fl.* Oct.–Febr., *fr.* March, Aug.–Oct.

23. *Symplocos fasciculata* ZOLL. Syst. Verz. 2 (1854) 136; Nat. Tijd. N. I. 14 (1857) 161; Miq. Fl. Ind. Bat. 1, 2 (1859) 467; Suppl. 1 (1861) 474, *incl. var. minor* Miq. l.c. 475; CLARKE, Fl. Br. Ind. 3 (1882) 574; K. & V. Bijdr. 7 (1900) 150, *incl. var. blumeana* K. & V. l.c. 151; BRAND, Pfl. R. Heft 6 (1901) 34; K. & G. J. As. Soc. Beng. 74, ii (1906) 235; KOORD. Atlas 2 (1914) t. 383; RIDL, Fl. Mal. Pen. 2 (1923) 301; HEYNE, Nutt. Pl. (1927) 1262; MERR. Un. Cal. Publ. Bot. 15 (1929) 248; BURK. Dict. (1935) 2113; CORNER, Ways. Trees (1940) 622, t. 231; BACK. & BAKH. f. Fl. Java 2 (1965) 205; NOOT. Leid. Bot. Ser. 1 (1975) 191, f. 2c, pl. 13. — *Sariava* REINW. Syll. Ratisb. 2 (1825) 12. — *Dicalyx tinctorius* BL. Bijdr. (1826) 1116, *non S. tinctoria* L'HÉRIT. 1791. — *Eugeniodes fasciculatum* O. K. Rev. Gen. Pl. 2 (1891) 409. — *S. phanerophlebia* MERR. Philipp. J. Sc. 9 (1914) Bot. 382; J. Str. Br. R. As. Soc. n. 76 (1917) 112; En. Philipp. 3 (1923) 301. — *Fig. 7.*

Shrub, or less often a tree to 22 m high and 50 cm \varnothing . Twigs sparsely pilose, puberulous, or appressedly pubescent, glabrescent, often zigzag. *Leaves* alternately or (on the leaders) spirally arranged, glabrous above, sparsely appressedly fine-hairy beneath, rarely patently hirsute, especially on midrib and nerves and towards the margin, (narrowly) elliptic or sometimes ovate, acuminate to caudate with acute to rounded base, 5–13(–18) by 2– $4\frac{1}{2}$ (–6) cm; nerves (4)6–8(–11) pairs, meeting in a looped intramarginal vein; petiole 2–8 mm. *Flowers* in a fascicle of reduced, often branched, racemes to $2\frac{1}{2}$ cm long. Bracts and bracteoles persistent, minute (rarely to 3 mm), as the axis pubescent; often several bracts present, indicating the origin from a more branched inflorescence. Pedicel 1–5 mm, pubescent. *Calyx* divided into (4)5(–6) broadly ovoid, rounded, appressedly pubescent or glabrous lobes, c. 1 mm long but sometimes the lobes different in size, often some of the lobes petaloid. *Corolla* glabrous or more often with minute hairs towards the outer base, rarely some hairs on the back too, 2– $4\frac{1}{2}$ mm. *Stamens* 12–35. Disk glabrous to more or less pilose, low annular.

Ovary appressedly hairy, c. 1 mm high; style hairy, especially towards the thickened base, rarely glabrous, 2– $3\frac{1}{2}$ mm. *Fruit* broadly or narrowly ampulliform, often curved, the belly globose or ovoid, the neck broadly conical, dark violet-blue or cobalt-blue, 5–7 by 3–5 mm; stone brain-like grooved without or with c. 10 shallow grooves. *Seed* 1, much lobed, with slightly curved embryo.

Distr. Extreme South Peninsular Thailand (Pattani) and throughout *Malesia*, except the Lesser Sunda Is., the Moluccas, and New Guinea. One of the most common *Symplocos* species in *Malesia*. *Fig. 17.*

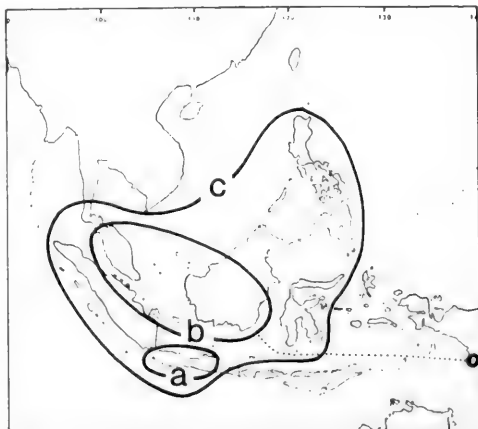


Fig. 17. Ranges of a. *Symplocos costata* (BL.) CHOISY, b. *S. cerasifolia* WALL. ex DC. *var. cerasifolia*, c. *S. fasciculata* ZOLL.

Ecol. In primary high and open secondary forest and thickets, common in disturbed forest, rather indifferent to soils, besides on latosols, recorded from sand (Banka), in Borneo from sandstone, black soils, seasonally swampy land and Dipterocarp forest, also riparian, in Udjong Kulon from raised coral limestone, from sea-level up to c. 2200 m. *Fl.* June–Sept. (Nov.–April), *fr.* Sept.–March. Several times flowers are noted to be scented, but once recorded as emitting a pervasive sour smell (Malaya, WHITMORE).

Vern. Malaya: *kērēnang*, *nasi-nasi*, *mēnasi* (obviously referring to the often unripe white fruit, resembling grains of cooked rice), M, Kepong, *sēbiak*, Selangor; Sumatra: *kayu loba-loba*, Asahan, *djarak bulau*, Pajakumbu, *djirok*, Kerintji, *kēkatja*, *lèlèbah*, Bengkalis, *pipi udan*, Karo, *lèbomèlukut*, M. Ulu, Palembang, *hapu-hapu*, *havu-havu*, h. h. *dèlok*, h. h. *itam*, h. h. *uding*, *kareut kareut uding*, *lihai-lihai uding*, Simalur, *gia*, Kepahiang, *kayu lebeu*, Palembang, *djarok*, Banka; Java: *djarak*, *djirok*, d. *leutik*, d. *prit*, d. *sasag*, d. *wulu*, J, S, *ki pilit*, S; Borneo: Sarawak: *jirah*, Iban, *pēriaboh*, Murut; Sabah: *labah*, *lèboh*, *loboh*, Kinabatangan, Kadasan lang, *giak*, Kedayan, *idabo*, Dusun; Brunei: *pachal ambok*; Kalimantan: *njam-njam*, Bulungan, *gumiting putèh*, Balikpapan.

Notes. The fruit is of a type usually containing a curved seed with curved embryo; here it is, however, only slightly curved.

In the herbarium sterile sheets are sometimes confused with *Eurya acuminata* which has, in Malaya, often the same vernacular names; cf. CORNER (1940).

Normally lateral shoots are collected which have a characteristic alternate phyllotaxis, but I have also found leader-shoots which have a spiral phyllotaxis flowering in Borneo.

In habit *S. fasciculata* is very similar to *S. laeteviridis* but its flowers are truly fasciated with more than 3 bracts under each flower and these persistent, a regular 5-lobed calyx, an ampulliform fruit with a ruminant seed and curved embryo. In *S. laeteviridis* the inflorescence is a raceme or panicle with 1 bract and 2 bracteoles under each flower and these caducous, a calyx which splits into a 3-lobed and a 2-lobed part, while the fruit is ellipsoid to ovate, with a non-ruminant seed and a straight embryo.

24. *Symplocos filipes* NOOT. Leid. Bot. Ser. 1 (1975) 193, pl. 14a-d. — **Fig. 7.**

Twigs glabrous or sparsely pulverulent-puberulous, the terminal buds small, with pulverulent-puberulous scales which often bear large vesicular glands on the margin. *Leaves* glabrous or sparsely pulverulent-puberulous beneath, \pm elliptic, long acuminate, with acute often attenuate base and entire or slightly denticulate margin which contains a row of large vesicular glands, $4\frac{1}{2}$ – $7\frac{1}{2}$ by 2–3 cm; nerves 5–6 pairs, meeting in a looped intramarginal vein; petiole 7–8 mm. *Flowers* in a lax raceme of 4–10 cm, the axis sparsely pulverulent-puberulous. Bracts and bracteoles persistent, with same indument, $\frac{1}{2}$ and 1 mm long respectively. Pedicel slender, 2–15 mm. *Calyx* sparsely pulverulent-puberulous, divided into semi-elliptic $\frac{1}{2}$ mm long lobes. *Corolla* c. 3 mm. *Stamens* c. 25. Disk annular, glabrous. *Ovary* with same indument as calyx, c. $1\frac{1}{2}$ mm high; style glabrous, c. 3 mm. *Fruit* ellipsoid, c. 10 by 4 mm, the small calyx incurved; stone spindle-shaped, with shallow lengthwise grooves, 1-celled. *Seed* 1, straight with straight embryo.

Distr. *Malesia*: Philippines (Mindoro: Mt Halcón), two collections.

25. *Symplocos gambliana* BRAND. Bull. Herb. Boiss. II, 6 (1906) 748; MERR. En. Born. (1921) 484; NOOT. Leid. Bot. Ser. 1 (1975) 195. — *S. havilandii* KING & GAMBLE, J. As. Soc. Beng. 74, ii (1906) 251, non BRAND, 1901.

Twigs glabrous. *Leaves* glabrous, \pm elliptic, abruptly oblique acuminate with acute, attenuate base and entire, recurved margin, 6–9 by 3– $4\frac{1}{2}$ cm; nerves 6–8 pairs meeting in a looped, faintly prominent intramarginal vein; petiole 5–10 mm. *Flowers* in a lax spike or raceme to 6 cm; axis glabrous. Bracts and bracteoles ?minute, soon caducous. Pedicel less than 1 mm. *Calyx* entirely divided into semi-orbicular, ciliate, $\frac{3}{4}$ – $1\frac{1}{2}$ mm long lobes. *Corolla* ciliate, often with some minute hairs on the outside, c. 5 mm. *Stamens* c. 50. Disk 5-glandular, with the style base minutely pilose. *Ovary* glabrous, c. 1 mm high; style glabrous except the base, 4 mm. *Fruit* not known.

Distr. *Malesia*: Borneo (Sarawak), only known from the type.

26. *Symplocos gigantifolia* NOOT. Leid. Bot. Ser. 1 (1975) 195.

Twigs glabrous, very thick. *Leaves* glabrous, obovate, shortly acuminate, the base cuneate but truncate at its lowermost part, margin \pm entire, 21–62 by 7–19 cm; nerves 13–20 pairs, merging into the venation; petiole c. 1 cm. *Flowers* in a fascicle or very short spike on wood. Bracts and bracteoles persistent, appressedly pubescent, semi-elliptic, rounded, 1–2 mm. *Calyx* minutely appressedly pubescent, 2 mm, the 3 semi-elliptic, rounded lobes c. $1\frac{1}{2}$ mm long. *Corolla* 4–5 mm. *Stamens* c. 50. Disk 5-glandular, glabrous, but style base pilose. *Ovary* with same indument as calyx, c. 1 mm high; style glabrous, reduced (only δ flowers seen). *Fruit* very young. *Seeds* not seen.

Distr. *Malesia*: East New Guinea (Central Division, Southern Highlands and Western District), 3 collections.

Ecol. In high forest, once along a riverbed, 90, 500, and 800 m. *Fl.* April–May.

Notes. BRASS (3894) noted that it is a 'striking tree with erect branching habit and flowers between the whorls.' In the three collections studied the 'whorled' position of the leaves could not be checked. Possibly the main leaves may be conspicuously crowded at the end of the year's growth (flush).

A similar situation is reported to occur in *S. herzogii*, which is the closest related species, differing in having smaller, hairy leaves, hairy twigs, and larger bracts.

27. *Symplocos glabriramifera* NOOT. Leid. Bot. Ser. 1 (1975) 196, pl. 15a-d. — **Fig. 7.**

Twigs glabrous. *Leaves* glabrous, elliptic to obovate, (faintly) acuminate, with acute, attenuate base and crenate or crenulate apex, 4– $6\frac{1}{2}$ by $1\frac{1}{2}$ – $2\frac{1}{2}$ cm; nerves 6–8 pairs, meeting in a looped intramarginal vein; petiole 5–7 mm. *Flowers* in a short lax raceme to $1\frac{1}{2}$ cm, axis glabrous. Bracts and bracteoles caducous, glabrous, ciliate, $1\frac{1}{2}$ and 1 mm long respectively. Pedicel 1–2 mm. *Calyx* glabrous, c. $1\frac{1}{2}$ mm long, the lobes 3, semi-elliptic, rounded, c. $1\frac{1}{4}$ mm long. *Corolla* probably 3-merous, 3–4 mm. *Stamens* 30–50. Disk glabrous, 3–5-glandular. *Ovary* glabrous, c. 1 mm high; style glabrous. *Fruit* ellipsoid, truncate at both ends, 8–12 by 4–6 mm; stone shallowly lengthwise grooved without, 3-celled. *Seed* 1 in each cell, straight with straight embryo.

Distr. *Malesia*: Philippines (Luzon: Benguet & Nueva Vizcaya Prov.).

Ecol. Mountain forest, 1900 m. *Fl.* Febr., May.

28. *Symplocos glomerata* KING ex CLARKE. Fl. Br. Ind. 3 (1882) 577; BRAND, Pfl. R. Heft 6 (1901) 69; BRANDIS, Ind. Trees (1906) 438; HAND.-MAZZ. Beih. Bot. Centralbl. 62 B (1943) 30; NOOT. Leid. Bot. Ser. 1 (1975) 199, pl. 16a–b, with full synonymy. — **Fig. 7.**

var. *glomerata*.

Small tree, 6 m. Twigs glabrous, or tomentellous and then soon glabrescent. *Leaves* elliptic, acuminate, with glandular dentate margin, 7–20 by

2–4½ cm; nerves 10–16 pairs meeting in a looped intramarginal vein; petiole 5–12 mm. *Flowers* in a fascicle from the axils of the leaves or from wood. *Calyx* glabrous, 1–2 mm, the ciliate lobes slightly shorter. *Corolla* 4–5 mm. *Stamens* c. 25 to c. 50. Disk cylindrical, c. 1 mm high. *Ovary* glabrous, c. 1 mm high. *Fruit* 7–10 by c. 3 mm.

Distr. Continental Asia (India, Burma, Indo-China, China, Hainan, Hong Kong, Formosa); in *Malesia*: Malay Peninsula (Trengganu, once found on G. Lawut Besut).

Ecol. Montane forest, 1500 m. *Fr.* April.

Note. There is a considerable synonymy involved in this widely spread continental SE. Asian species which I have subdivided into two subspecies and several varieties.

29. *Symplocos goodeniacea* Noot. Leid. Bot. Ser. 1 (1975) 204.

Small tree to 7½ m. Twigs glabrous. *Leaves* narrowly elliptic, shortly acuminate with cuneate base and recurved entire or denticulate margin, 17–30 by 3½–7 cm; nerves 11–13 pairs, at least in the apical part of the leaf meeting in a looped intramarginal vein close to the margin; petiole 15–25 mm. *Flowers* in a spike to 4 cm; axis puberulous. Bracts and bracteoles persistent, glabrous but ciliate, c. 2 mm. *Calyx* glabrous, divided into the broadly rounded 1½–2 mm long lobes. *Corolla* 6–8 mm. *Stamens* more than 100. Disk annular, minutely pilose. *Ovary* glabrous, 1½–2 mm high; style glabrous. *Fruit* not known.

Distr. Malesia: Borneo (Sabah), only known from the type.

Ecol. Lowland rain-forest, 150 m.

30. *Symplocos herzogii* SLEUM. in Fedde, Rep. 42 (1937) 264; Noot. Leid. Bot. Ser. 1 (1975) 207. — Fig. 7.

Small tree or leaning shrub, 4–6 m high. Twigs thick, densely tomentose. *Leaves* pseudoverticillate, but between the whorls the scars of fallen spirally arranged leaves visible in at least one collection, rather densely hairy beneath, especially on midrib and nerves, ± elliptic, acute to acuminate with cuneate base (the very base truncate) and sharply dentate margin, 13–20 by 5–9½ cm; nerves 10–17 pairs; petiole with same indument as twigs, very thick, 7–20 mm. *Flowers* in a fascicle or spike to 2 cm from the axils of the leaves or from wood. Bracts and bracteoles persistent, densely reddbrown sericeous, c. 5 mm and c. 3 mm respectively. *Calyx* appressedly reddbrown hairy, 2–2½ mm, the lobes ± ovate, acute, 1½–2 mm. *Corolla* 3–4 mm. *Stamens* c. 40 in ♂ flowers (according to SLEUMER l.c. absent in ♀ flowers). Disk pilose. *Ovary* glabrous, ½–1 mm high; style reduced in ♂ flowers, in ♀ flowers 3½ mm (according to SLEUMER l.c.). *Fruit* globose to ampulliform, c. 8 by 6 mm, the stone ribbed. *Seed* 1, curved with curved embryo.

Distr. Malesia: East New Guinea (Morobe Distr.).

Ecol. Midmountain rain-forest, 1500–1800 m. *Fl.* Dec.–April.

Notes. I have only seen ♂ flowers and fruits. According to SLEUMER ♀ flowers are few, at the base of the inflorescence.

This species is allied to *S. gigantifolia*; see the notes under that species.

31. *Symplocos johniana* STAPP, Trans. Linn. Soc. Bot. 4 (1894) 206; BRAND, Pfl. R. Heft 6 (1901) 65; MERR. En. Born. (1921) 487; H. HEINE, Pfl. Samml. Clemens Kinabalu (1953) 88; NOOT. Leid. Bot. Ser. 1 (1975) 208, pl. 17f–g. — Fig. 7.

Shrub or small tree, to 3 m. Twigs densely obliquely to patently rusty hirsute. *Leaves* spirally arranged or alternate, rather densely patently hirsute beneath, or only midrib and nerves hairy, acuminate to caudate with rounded to cordate base and usually rather coarsely sharp-dentate margin, ovate, 2½–7 by 1¼–3½ cm; nerves 3–6 pairs meeting in a looped intramarginal vein; petiole 1–2 mm. *Flowers* in 1-flowered raceme, axis ½ mm, with 1½ mm long bract and the c. 1 mm long bracteoles loosely appressedly rusty hirsute. Pedicel c. 1 mm. *Calyx* rusty hirsute, divided into the semi-elliptic rounded 1–1½ mm long lobes. *Corolla* c. 5 mm. *Stamens* 60–90. Disk stellate, densely hirsute. *Ovary* rusty hirsute, c. 1 mm high; style glabrous, c. 6 mm. *Fruit* narrowly flask-shaped, often sparsely hairy, intense indigo-blue, c. 13 by 4 mm, the persistent calyx not included. *Seed* 1, straight, narrowly elliptic, embryo straight.

Distr. Malesia: Borneo (Sabah: Mt Kinabalu; W. Kutei; G. Kemul).

Ecol. In forest, in damp shady places, often in crevices of granite rocks, 1500–3200 m. *Fl.* Febr.–Oct., *fr.* Febr.–May, Sept.–Oct.

Note. The distribution is interesting because this species, which was assumed to be a Kinabalu endemic, is also found on an old, worn-down, rather low summit in W. Kutei, in a mountain range which is probably older than Mt Kinabalu. This feature is also found in some other mountain plants, e.g. *Lobelia borneensis*, which were found on Mt Murud, in Sarawak (cf. STEEN. Proc. R. Soc. Lond. B 161, 1964, 16). VAN STEENIS concluded that Kinabalu plants possibly in the past had a wider distribution in Borneo when there were more higher peaks in the island, and that the few present stations on the low mountains are relict stations (cf. also STEEN. Mal. Nat. J. 20, 1967, 39).

32. *Symplocos junghuhnii* KOORD. Proc. Kon. Acad. Wet. A'dam 10 (1908) 160; Noot. Leid. Bot. Ser. 1 (1975) 209. — Fig. 7, 18.

Twigs glabrous. *Leaves* glabrous, or with some appressed hairs beneath, acuminate with cuneate to cordate base and entire to denticulate margin, obovate to elliptic, 9–13 by 4½–5 cm; nerves 7–10 pairs; petiole 10–17 mm. *Flowers* in a raceme to 6 cm, axis pubescent to tomentose, glabrescent. Bracts and bracteoles soon caducous, not seen. *Calyx* glabrous, divided into ± semi-orbicular cordately based c. 2 mm long lobes. *Corolla* 8–10 mm. *Stamens* more than 100. Disk 5-glandular, with the broadly conical style base soft hairy. *Ovary* tomentose, 2–3 mm high; style glabrous, c. 7 mm. *Fruit* (only young fruits seen) ± elliptic, 15 by 8 mm. Embryo probably straight.

Distr. Malesia: West Java (Preanger: Tjigen-teng).

Ecol. Mixed montane rain-forest, 1750 m.

Note. It is not clear why this species was omitted from BACK. & BAKH. f.'s Flora of Java.

33. *Symplocos laeteviridis* STAPP, Trans. Linn. Soc. Bot. 4 (1894) 205; BRAND, Pfl. R. Heft 6 (1901) 53;

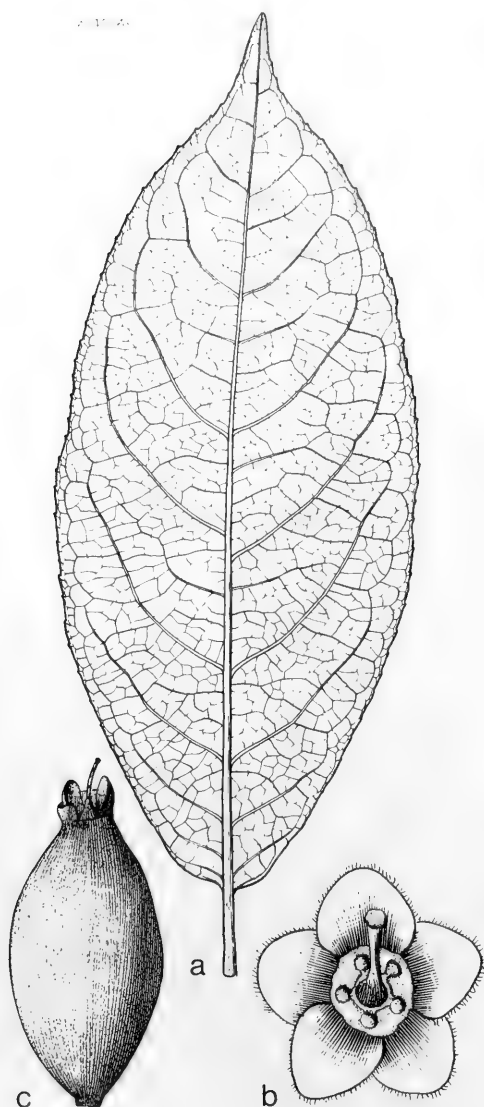


Fig. 18. *Symlocos junghuhnii* KOORD. a. Leaf underside, nat. size, b. deflorated flower from above, showing 5-glandular disk, $\times 4$, c. fruit, $\times 2$ (KOORDERS 26420).

MERR. EN. BORN. (1921) 487; AIRY SHAW, Kew Bull. (1939) 408; H. HEINE, Pfl. Samml. Clemens Kinabalu (1953) 88; NOOT, Leid. Bot. Ser. 1 (1975) 208, pl. 18-19. — Fig. 3.

For synonyms see under the varieties.

Shrub or tree to 10(-21) m. Twigs glabrous or clothed by a much variable indument, often faintly zigzag. Leaves alternate, glabrous to more or less pilose beneath, acuminate to caudate with acute to

cordate base and nearly entire finely glandular dentate or sharply dentate, flat or recurved, margin, (narrowly) ovate to elliptic, $1\frac{3}{4}$ -12 by $1-4\frac{1}{2}$ cm; nerves (3-4) 11 pairs, usually meeting in a looped intramarginal vein. Flowers in a raceme or panicle to $4\frac{1}{2}$ cm, the axis clothed with hairs. Bracts and bracteoles hairy, soon caducous. Pedicels 0-5 mm. Calyx glabrous or hairy, 2-3 mm long, symmetrically cleft, the lobes 1-3 mm. Corolla 3-5 mm, often with minute hairs on the outside. Stamens 25-70. Disk 5-stellate, shortly minutely pilose. Ovary (appressedly) hairy, $1-1\frac{1}{2}$ mm high; style glabrous, as long as the corolla. Fruit white to bluish-black, (obliquely) ovoid to ellipsoid, 7-12 by (3-5) 6 mm. Seed 1, cylindrical to ellipsoidal or ovoid with straight embryo.

Distr. Malesia: N. Sumatra, Malaya, Borneo, and Celebes.

Note. See for differences with *S. fasciculata* under that species.

KEY TO THE VARIETIES

1. Leaf base distinctly cordate.
 2. Twigs with an indument of c. 2 mm long hairs. Leaves 5-12 cm long . . . e. var. *mjöbergii*
 2. Twigs with an indument of $\frac{1}{4}$ -1 mm long hairs. Leaves $1\frac{3}{4}$ - $4\frac{1}{2}$ cm long. . . d. var. *kinabaluensis*
1. Leaf base cuneate to rounded.
 3. Twigs velutinous.
 4. Leaves c. 4 cm long . . . f. var. *pauciflora*
 4. Leaves 9-12 cm long. . . g. var. *velutinos*
 3. Twigs glabrous, or pubescent, hairs much shorter than 2 mm.
 5. Twigs glabrous or appressed-pubescent. Nerves 6-9 pairs. . . a. var. *laeteviridis*
 5. Twigs loosely appressed-pubescent. Nerves 3-6 pairs . . . b. var. *alternifolia*
 3. Twigs obliquely to patently long-pilose, hairs of the indument c. 2 mm long.
 - c. var. *basirotunda*

a. var. *laeteviridis*. — Cf. NOOT, Leid. Bot. Ser. 1 (1975) 211, pl. 18e-f, 19b. — *S. forbesii* BRAND, Pfl. R. Heft 6 (1901) 63. — Fig. 3, 7.

Shrub or tree to 10(-21) m. Twigs glabrous or appressedly pubescent. Leaves often yellowish green above, brownish beneath *in sicco*, acuminate to caudate with cuneate to rounded base (narrowly) elliptic to ovate, 4-11 by $1\frac{1}{2}$ -4 cm; nerves 6-9 pairs, usually meeting in a looped intramarginal vein; petiole 1-3(-4) mm. Flowers in a predominantly basally branched, often very short lax panicle of racemes, rarely a simple raceme, to 3 cm long; axis pubescent. Bracts and the 0-1 bracteoles very soon caducous. Pedicel with same indument as axis, 0-2(-5) mm. Fruit black-blue.

Distr. Malesia: N. Sumatra, Banka, Malay Peninsula (Perak, once), Borneo (throughout, many collections from Mt Kinabalu), SW. Celebes (Bonthain, Todjambu).

Ecol. In hill and montane rain-forest, in a variable set of conditions, on rich clay in mixed Dipterocarp forest near a river, on stony hillsides, on black soil on ridge top, on a basalt ridge under Dipterocarp forest (Sarawak), and even on ultra-basalt; 500-2000 m. Fl. Jan.-Oct., fr. almost Jan.-Dec.

Vern. Sumatra: *alleban*, Karolands, *kayu loba-loba*, *k. sae-sae*, Asahan; Borneo: Sarawak: *luroh*, Kayan.

b. var. *alternifolia* NOOT. Leid. Bot. Ser. 1 (1975) 211, pl. 18a.

Shrub or treelet. Twigs densely loosely appressedly brown-pubescent. Leaves rather densely to sparsely appressed-pilose beneath, especially on the margin, acuminate to caudate with cuneate shortly attenuate base and ciliate, recurved, entire to finely glandular dentate margin, \pm elliptic, 4–5½ by 1½–2½ cm; nerves (3–)4–6 pairs, meeting in a looped intramarginal vein but sometimes obscured by the indument; petiole *c.* 2 mm. Flowers in a (sometimes branched) raceme to 3 cm or solitary, axis red-brown pilose. Pedicel 0–½ mm (to 4 mm in solitary flowers).

Distr. *Malesia*: Borneo (Sabah: Mt Kinabalu). Ecol. Montane rain-forest, 1000–1500 m. *Fl.* May.

c. var. *basitunda* NOOT. Leid. Bot. Ser. 1 (1975) 212, pl. 18b.

Shrub or treelet. Twigs obliquely to patently long-pilose. Leaves glabrous to sparsely appressedly long-pilose beneath, acuminate to caudate with rounded to subcordate base and sharply glandular dentate to nearly entire margin, elliptic, 3–11 by 1¾–3½ cm; nerves 6–9 pairs, meeting in a looped intramarginal vein; petiole 1–2 mm. Flowers in a raceme or panicle to 2 cm, axis pilose. Pedicels 0–2(–3) mm. Fruit blue.

Distr. *Malesia*: Borneo (Sarawak: Kalabit Up-lands).

Ecol. Montane rain-forest, on humus on sandstone, and on podsolized sand (kerangas), 1000–1700 m. *Fl.* March–April, *fr.* April, Aug.

d. var. *kinabaluensis* (HEINE) NOOT. Leid. Bot. Ser. 1 (1975) 212, pl. 19c. — *S. kinabaluensis* HEINE, Mitt. Bot. Staatssamml. München 6 (1953) 217.

Shrub or small tree to 4 m. Twigs shortly obliquely hairy. Leaves acuminate with cordate base and finely glandular-dentate margin, ovate to elliptic, 1¾–4½ by 1–2¾ cm; nerves 4–6 pairs; petiole *c.* ½ mm. Flowers in a \pm 3-flowered raceme to 3 cm, axis with same indument as twigs. Bracts 3–5 mm, leaf-like, soon caducous. Pedicel ½–5 mm.

Distr. *Malesia*: Borneo (Sabah: Mt Kinabalu).

Ecol. Montane rain-forest, also secondary forest, and in landslip regrowth, on black or clay soils, 1400–2300 m. *Fl.* Febr., May–Sept., *fr.* March, Aug., Nov.–Dec.

e. var. *mjöbergii* (MERR.) NOOT. Leid. Bot. Ser. 1 (1975) 212, pl. 18g. — *S. mjöbergii* MERR. Sar. Mus. J. 3 (1928) 546. — Fig. 7.

Small tree. Twigs patently brown or rusty pilose. Leaves (narrowly) elliptic or ovate, acuminate, base cordate with 2–10 mm long lobes, margin finely glandular dentate, 5–12 by 2½–4½ cm; nerves strongly impressed above, in 6–9 pairs, meeting in a conspicuous looped intramarginal vein; petiole *c.* 1½ mm. Flowers in a predominantly basally branched panicle to 4 cm, the axis \pm patently brown or rusty pilose. Bracts often

leaflike, and then up to 10 mm. Pedicels 1–5 mm. Fruit from green to purple, finally bluish.

Distr. *Malesia*: Borneo (Sabah: Mt Kinabalu; Sarawak: Mt Murud).

Ecol. Montane rain-forest, also in secondary forest, along hillsides and streams, in *Agathis-Podocarpus*-oak forest, sometimes on blackish soil, 1200–2400 m. *Fl.* Aug.–Nov., *fr.* Dec.–June.

f. var. *pauciflora* NOOT. Leid. Bot. Ser. 1 (1975) 213, pl. 18c–d.

Shrub. Twigs velutinous. Leaves glabrous except the appressedly pilose midrib and the recurved finely dentate margin underneath, or appressedly fine-pilose beneath, acuminate with rounded base, elliptic, *c.* 4 by 2 cm; nerves *c.* 5–7 pairs, meeting in a looped intramarginal vein; petiole with same indument as twigs, *c.* 2 mm. Flowers in a 1–5-flowered raceme up to 3 cm; axis patently pubescent. Pedicel 0–½ mm, but much longer when flowers solitary. Fruit blue.

Distr. *Malesia*: Borneo (Sabah: Mt Kinabalu; Sarawak: Mt Murud).

Ecol. Montane rain-forest, often mossy, on ridges, also in scrub forest, 1700–2570 m. *Fl.* April, July, Oct., *fr.* April.

g. var. *velutinos* NOOT. Leid. Bot. Ser. 1 (1975) 213, pl. 19a.

Treelet to *c.* 10 m. Twigs velutinous. Leaves glabrous above, more or less appressedly pilose beneath, especially on the nerves and the sharply dentate flat margin, acuminate with rounded base, (narrowly) elliptic, 9–12 by 3–4 cm; nerves 7–11 pairs, meeting in a conspicuous looped intramarginal vein; petiole 3–4 mm. Flowers in a panicle to 3 cm, axis patently pilose. Bracts and the 0–3 mm long pedicels with same indument.

Distr. *Malesia*: Borneo (Sabah: Mt Kinabalu; Sarawak: Kapit area).

Ecol. Primary and old secondary rain-forest, 1000–1500 m. *Fl.* Aug.–Oct.

34. *Symplocos lancifolia* S. & Z. Fam. Nat. 2 (1846) 133; CLARKE, Fl. Br. Ind. 3 (1882) 577; BRAND, Pfl. R. Heft 6 (1901) 41; NOOT. Leid. Bot. Ser. 1 (1975) 214, pl. 21a–d, with full synonymy. — *S. montana* VIDAL, Rev. Pl. Vasc. Filip. (1886) 179, non BRONGN. & GRIS, 1866. — *S. luzoniensis* ROLFE, J. Bot. 24 (1886) 348; BRAND, Pfl. R. Heft 6 (1901) 61; Philip. J. Sc. 3 (1908) Bot. 9; ROLFE, Kew Bull. (1912) 157; BRAND, Philip. J. Sc. 7 (1912) Bot. 35; MERR. En. Philip. 3 (1923) 300. — *S. depauperata* MERR. Publ. Gov. Lab. Philip. n. 29 (1905) 45; BRAND, Philip. J. Sc. 3 (1908) Bot. 10, incl. var. *sordida* BRAND; *ibid.* 7 (1912) Bot. 36, incl. var. *angustissima* BRAND; MERR. En. Philip. 3 (1923) 298. — *S. merrilliana* BRAND, Philip. J. Sc. 3 (1908) Bot. 9. — *S. betula* BRAND, l.c. 8; MERR. En. Philip. 3 (1923) 297; NOOT. Leid. Bot. Ser. 1 (1975) 133. — *S. inconspicua* BRAND, Philip. J. Sc. 4 (1909) Bot. 110; MERR. En. Philip. 3 (1923) 299. — *S. zamboangensis* BRAND in Fedde, Rep. 14 (1916) 325; MERR. En. Philip. 3 (1923) 303. — Fig. 7.

Low shrub 1–2 m or tree to 20 m. Twigs appressedly to patently hairy, soon glabrescent. Leaves often sparsely appressedly fine-hairy beneath, acuminate, with cuneate to nearly rounded base

and mostly finely glandular dentate or undulate margin, (narrowly) ovate, 2–10 by $1\frac{1}{2}$ – $4\frac{1}{4}$ cm; midrib above prominent to slightly sulcate; nerves (4)–6–11 pairs, often meeting in a looped intramarginal vein; petiole 1–3(–5) mm. *Flowers* in a raceme to 3(–7) cm. Bracts and bracteoles persistent but falling in fruit, $\frac{1}{2}$ –2 and $\frac{1}{2}$ – $1\frac{1}{2}$ mm respectively. Pedicel 0–1 mm. *Calyx* usually sparsely appressedly fine short-hairy or pubescent, rarely glabrous, divided into $\frac{1}{2}$ – $1\frac{1}{2}$ mm long lobes. *Corolla* $2\frac{1}{2}$ –4 mm. *Stamens* 15–40. Disk 5-glandular, mostly hairy including the style base. *Ovary* with same indument as calyx or glabrous, $\frac{1}{2}$ – $1\frac{1}{2}$ mm high. *Fruit* ellipsoid to globose, 3–5 by 2–5 mm, the calyx forming a blunt beak on top; stone smooth. *Seed* 1, filling the whole fruit, with U-shaped embryo.

Distr. Continental SE.-E. Asia (N. India, Indo-China, China, Hainan, Hong Kong, Ryu Kyu Is., Formosa); in *Malesia*: Philippines (Luzon, Mindoro, Panay, Negros, Mindanao).

Ecol. In a variety of habitats, also in dense mossy forest at higher altitude, 400–2500 m. *Fl.* Dec.–April, *fr.* May–Dec. Flowers noted as scentless.

35. *Symplocos lucida* (THUNB.) S. & Z. *Fl. Jap.* 1 (1835) 55, t. 24, *excl. syn. Myrtus laevis*; OHWI, *Fl. Jap.* (1965) 727; NOOT, *Leid. Bot. Ser.* 1 (1975) 217, with full synonymy. — *Laurus lucida* THUNB. *Fl. Jap.* (1784) 174. — *Hopea lucida* THUNB. *Fl. Jap.* (1800) t. 4. — *S. theaeifolia* D. DON, *Fl. Nepal.* (1825) 145; BRAND, *Pfl. R.* Heft 6 (1901) 66 ('*theifolia*'); HALL, *f. Med. Rijksherb.* 14 (1912) 40; BACK, & BAKH, *f. Fl. Java* 2 (1965) 205. — *Dicalyx ciliatus* BL. *Bijdr.* (1826) 1119. — *S. ciliata* MRO, *Fl. Ind. Bat.* 1, 2 (1859) 466; K. & V. *Bijdr.* 7 (1900) 155; BRAND, *Pfl. R.* Heft 6 (1901) 65. — *S. ridleyi* KING & GAMBLE, *J. As. Soc. Beng.* 74, ii (1906) 239; RIDL, *Fl. Mal. Pen.* 2 (1923) 302. — *S. loheri* BRAND, *Philip. J. Sc.* 7 (1912) Bot. 32; MERR, *En. Philip.* 3 (1923) 300. — *S. laeviramulosa* ELMER, *Leaf. Philip. Bot.* 7 (1914) 2323; MERR, *En. Philip.* 3 (1923) 300. — *Fig. 7.*

Shrub or tree to 20 m, 25 cm ϕ . Twigs glabrous, yellowish green, angular when dry. *Leaves* coriaceous, glabrous (sometimes quite thin), acute or obtuse with cuneate base and entire or glandular dentate revolute margin, \pm elliptic, 5–12 by 2– $4\frac{1}{2}$ cm; midrib more or less prominent on the upper surface, often sulcate towards the base; nerves 5–15 pairs, prominent on both upper and under-surface; petiole 5–15 mm. *Flowers* in a basally branched short dense raceme or condensed spike of $1\frac{1}{2}$ –4 cm; axis puberulous or pubescent. Bracts and bracteoles persistent under the fruit, glabrous, or sometimes pubescent or puberulous on midrib and base, 1–3 mm. Pedicels 0–5 mm. *Calyx* mostly glabrous, nearly divided into 5 lobes, 1–3 mm. *Corolla* 3–5 mm. *Stamens* 10–70. Disk densely hairy. *Ovary* glabrous, $\frac{1}{2}$ –2 mm high; style glabrous, or hairy, mostly towards the base. *Fruit* ellipsoid (to rarely nearly orbicular), 1–3-celled, 5–18 by 4–15 mm, the wider ones with 2 seeds. *Seeds* usually U-shaped with U-shaped embryo, in the 3-celled fruits the seeds abortive or (at most) V-shaped; the legs of the U are either separated by a septum or not.

Distr. Continental SE.-E. Asia (N. India, N.

Burma, N. Thailand, Indo-China, China, Hong Kong, Hainan, Japan, Ryu Kyu Is., Formosa); throughout *Malesia*, except Borneo, the Moluccas, and New Guinea.

Ecol. High and low mountain forest, elfin forest, and mossy forest at higher altitude, also in tjemara forest, 1500–3000 m. *Fl.* (July) Oct.–Nov., *fr.* July (April–Oct.). In habit very much resembling the Theaceous *Pyrenaria serrata* BL. which grows in similar forest.

Vern. Sumatra: *kayu hotir*, Asahan; Java: *djarak lulub*, S, *djirék*, J.

36. *Symplocos maliliensis* NOOT. *Leid. Bot. Ser.* 1 (1975) 237. — *Fig. 7.*

Tree, 25–30 m, 30–40 cm ϕ . Twigs glabrous. *Leaves* acuminate, base cuneate, often the very base rounded, margin entire, recurved, (narrowly) obovate, 15–22 by $4\frac{1}{2}$ – $8\frac{1}{2}$ cm; nerves 9–14 pairs, meeting in a looped intramarginal vein; petiole 8–15 mm. *Flowers* in a raceme to 8 cm, axis pubescent. Bracts and bracteoles caducous, pubescent, ovate, 3–4 and 2–3 mm long respectively. Pedicel to 2 mm. *Calyx* glabrous, oblique, 3–4 mm, the lobes ovate, 2–3 mm. *Corolla* c. 6 mm. *Stamens* c. 100 or more. Disk shortly pilose. *Ovary* glabrous, 1–2 mm high; style with broadly conical shortly pilose base, the rest glabrous, c. 5 mm. *Fruit* ellipsoid, 15–20 by 10–12 mm, stone with c. 6 lengthwise ridges, mostly 2-celled. *Seeds* not seen.

Distr. *Malesia*: Central Celebes (Malili).

Ecol. Primary high rain-forest, at low altitude, c. 200 m. *Fl.* June–July, *fr.* Febr., Sept.

Vern. *Lako*, *kandoa*, Tobela lang.

37. *Symplocos wikstroemifolia* HAYATA, *Pl. Form.* 5 (1915) 119, t. 25b; MORI, *Sylvia* 5 (1934) 249; KANEH. *Form. Trees rev. ed.* (1936) 602, t. 560. — *S. microtricha* HAND.-MAZZ. *Beih. Bot. Centralbl.* 62 B (1943) 17; NOOT, *Leid. Bot. Ser.* 1 (1975) 239. — *Fig. 7.*

Shrub $1\frac{1}{2}$ m, or tree to 20 m. Twigs sometimes soon thickened, tapering towards the apex. *Leaves* often only towards the end of the twigs, minutely sparsely appressedly fine hairy beneath, acuminate, with cuneate base and nearly entire margin, (narrowly) elliptic to obovate, 6– $15\frac{1}{2}$ by $1\frac{3}{4}$ – $4\frac{1}{2}$ cm; midrib above prominent or sunken, flat or slightly sulcate; nerves 8–10 pairs, joined in an intramarginal looped vein 1–3 mm from the margin; petiole 3–10 mm. *Flowers* in an often branched spike from the axils of the leaves, the lower ones from wood. Bracts and bracteoles soon caducous, appressedly pubescent, 1– $1\frac{1}{4}$ and 1 mm respectively. *Flowers* δ or γ , probably all flowers on one plant alike. *Calyx* divided into c. 1 mm long semi-orbicular or semi-elliptic lobes, glabrous, or the outer lobes appressedly fine pubescent. *Corolla* 2–3 mm. *Stamens* 15–20 in δ flowers, 5, alternipetalous, in γ flowers (observed once). Disk pulvinate, glabrous or (minutely) shortly pilose. *Ovary* glabrous or finely appressedly short hairy, $\frac{1}{2}$ mm high in δ , 1– $1\frac{1}{2}$ mm in γ flowers; style glabrous, 2 mm, with thick, knob-like stigma, but aborted in δ flowers. *Fruit* ovoid, or slightly constricted towards the apex, 10–12 by 6–8 mm. *Seed* 1, curved, with curved embryo.

Distr. Continental SE. Asia (Indo-China, China, Hainan, Formosa); in *Malesia*: Malay

Peninsula (Pahang: G. Paking, G. Benom, Fraser's Hill, G. Tahan).

Ecol. In hill forest, on mossy or exposed ridges, 1300–1500 m. *Fl.* Febr.–March, *fr.* Oct. In elfin forest noted to assume a fastigate habit. Flowers often in part ramiflorous.

38. *Symplocos multibracteata* NOOT. Leid. Bot. Ser. 1 (1975) 241. — Fig. 19.

Small shrub, $\frac{3}{4}$ –1 $\frac{1}{4}$ m, or treelet to 4 m. Twigs densely appressedly to patently (softly) pilose to nearly glabrous. *Leaves* acuminate with rounded to cordate base and glandular denticulate to dentate margin, elliptic to ovate, 5–14 by 2 $\frac{1}{2}$ –5 $\frac{1}{2}$ cm; nerves 7–13 pairs, meeting in a looped intramarginal vein; petiole 2–10 mm. *Flowers* in a reduced spike of at most 2 cm, usually only 1 (subterminal) flower left, sometimes another flower present in bud, axis glabrous. Bracts many, appressedly pubescent, 4–8 cm. *Calyx* divided into the appressedly pubescent 3–5 mm long lobes. *Corolla* 5–8 mm. *Stamens* 80 to more than 150. Disk softly pilose. *Ovary* glabrous, 2–3 mm high; style glabrous, to 2 $\frac{1}{2}$ mm long. *Fruit* obliquely ovoid to ellipsoid to spindle-shaped, 17–22 by 8–10 mm. *Seed* 1, filling the whole stone, with the embryo straight or slightly curved.

Distr. *Malesia*: East New Guinea (W. & E. Highlands).

Ecol. Montane rain-forest and depleted *Castanopsis-Nothofagus* forest, 2000–2300 m. *Fl.* July, Sept., *fr.* Aug., Jan.

Vern. *Chandujant*, Wabag, Enga lang.

39. *Symplocos nivea* BRAND, Pfl. R. Heft 6 (1901) 36; K. & G. J. As. Soc. Beng. 74, ii (1906) 234; RIDL. Fl. Mal. Pen. 2 (1923) 300; NOOT. Leid. Bot. Ser. 1 (1975) 241.

Tree to 18 m. Twigs glabrous. *Leaves* acuminate with cuneate, attenuate base and entire to obscurely undulate-crenate margin, glabrous, (narrowly) elliptic, 7–11 by 2–4 $\frac{1}{2}$ cm; nerves 5–8 pairs, meeting in an intramarginal vein 2–5 mm from the margin; petiole 7–10 mm. *Flowers* in a panicle of racemes, axis villous. Bracts and bracteoles glabrous, soon caducous, 2 $\frac{1}{2}$ –3 and c. 2 $\frac{1}{2}$ mm long respectively. Pedicel pubescent, to 5 mm long. *Calyx* glabrous, 2 $\frac{1}{2}$ –3 mm, the lobes 1–2 mm long, becoming longer by tearing apart. *Corolla* c. 5 mm. *Stamens* more than 100. Disk 5-glandular, with the broadly conical style base soft hairy. *Ovary* glabrous, c. 1 mm high; style glabrous, c. 5 mm. *Fruit* not known.

Distr. *Malesia*: Malay Peninsula (Penang, Johore), 2 collections.

Ecol. Hill rain-forest.

Note. Closely allied to *S. pyriflora* RIDL., differing in the number of nerves and with shorter corolla. May in future prove to be conspecific.

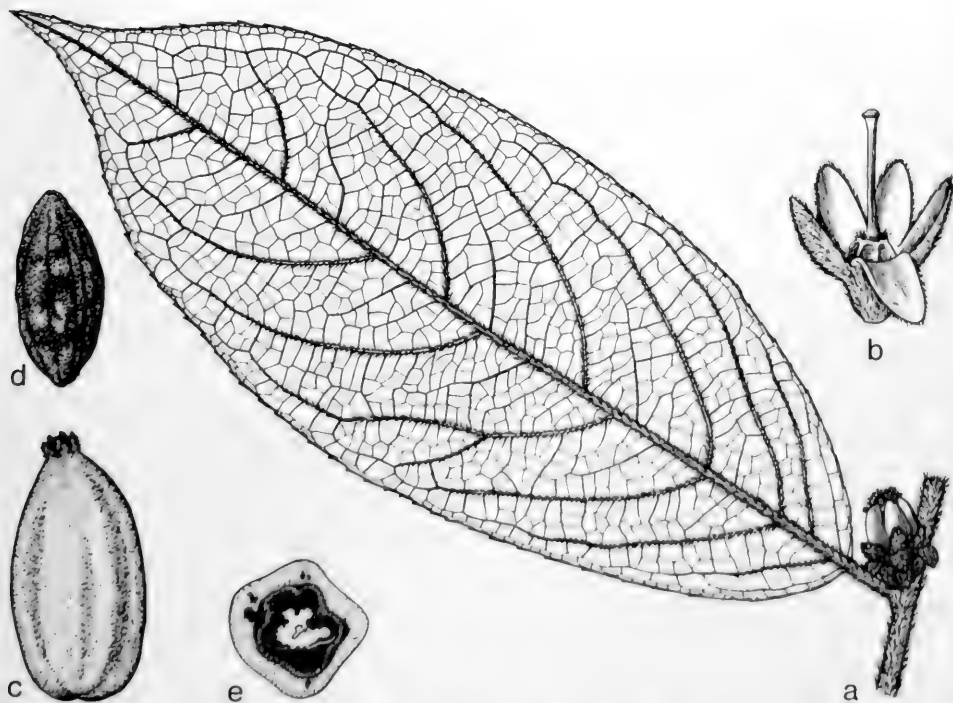


Fig. 19. *Symplocos multibracteata* NOOT. a. Leaf and flower, nat. size, b. deflorated flower, showing 5-lobed hairy disk, c. fruit, d. endocarp, e. fruit in CS, all $\times 2$ (a–b HOOGLAND 5882, c–e HOOGLAND 5887).

40. *Symplocos obovatifolia* MERR. Philip. J. Sc. 12 (1917) Bot. 290; En. Philip. 3 (1923) 300; NOOT. Leid. Bot. Ser. 1 (1975) 242. — Fig. 7.

Twigs glabrous. *Leaves* glabrous, rounded or shortly acuminate with cuneate, attenuate base and entire or glandular denticulate apex, obovate, $7\frac{1}{2}$ –11 by $3\frac{1}{2}$ –6 cm; nerves 7–9 pairs, meeting in a looped intramarginal vein; petiole 7–12 mm. *Flowers* in a fascicle or short spike to $1\frac{1}{2}$ cm, axis glabrous. Bracts and bracteoles glabrous, persistent, 2–3 mm. Only fruits seen. *Calyx* 3-lobed, glabrous, elliptic, rounded, c. 2 mm. Disk glabrous, style base shortly pilose. *Fruit* (obliquely) ellipsoid, c. 11 by 5 mm, the persistent calyx not included; stone smooth, 3-celled. *Seed* 1 in each cell, straight with straight embryo.

Distr. *Malesia*: Philippines (Luzon, Mt Umin-gan, Nueva Ecija), 2 collections.

Ecol. Hill rain-forest. Fr. Aug.–Sept.

41. *Symplocos odoratissima* (BL.) CHOISY ex ZOLL. Syst. Verz. 2 (1854) 136; MIQ. Fl. Ind. Bat. 1, 2 (1859) 468; GÜRKE in E. & P. Nat. Pfl. Fam. 4, 1 (1891) 170; K. & V. Bijdr. 7 (1900) 148, incl. var. *aluminosa* K. & V. l.c. 150; BRAND, Pfl. R. Heft 6 (1901) 35, incl. var. *divaricata* BRAND; K. & G. J. As. Soc. Beng. 74, ii (1906) 233; KOORD. Atlas 2 (1914) t. 382; RIDL. Fl. Mal. Pen. 2 (1923) 299; S. MOORE, J. Bot. 63 (1925) Suppl. 65, incl. var. *leptocarpa* S. MOORE; HEYNE, Nutt. Pl. (1927) 1263; BURK. Dict. 2 (1935) 112; BACK. & BAKH. f. Fl. Java 2 (1965) 205; NOOT. Leid. Bot. Ser. 1 (1975) 245. — *Dicalyx odoratissimus* BL. Bijdr. (1826) 1116. — *Euginodes odoratissima* O. K. Rev. Gen. Pl. 2 (1891) 975.

For further synonyms see under the varieties.

Tree (shrub) to 30 m high and 50 cm \varnothing . Twigs glabrous or tomentellous to tomentose or pubescent. *Leaves* glabrous or pubescent beneath, especially on midrib and nerves, with blunt, usually acuminate apex, acute to rarely rounded base and entire or mostly crenulate or dentate margin, (narrowly) elliptic to obovate, 7–20(–40) by $(2\frac{1}{2})$ –5–10(–20) cm; nerves 5–13(–16) pairs; petiole stout, 1–5 cm. *Flowers* mostly many in a 5–30 cm long panicle which is sometimes only branched towards the base, the axes rusty tomentellous. Bracts at the base of the 3–7 mm long pedicel, 3–5 mm, bracteoles directly under each flower, both tomentellous on both surfaces, caducous. *Calyx* tomentellous, the lobes blunt, $\frac{1}{2}$ – $1\frac{1}{2}$ mm. *Corolla* usually tomentellous, at least in bud, rarely nearly glabrous, 5–8 mm. *Stamens* more than 100. Disk hairy with 5 conspicuous glands. *Ovary* with same indument as calyx, $1\frac{1}{2}$ – $2\frac{1}{2}$ mm high; style pilose towards the conical base, about as long as the corolla. *Fruit* glabrous or tomentellous, (obliquely) ovoid (or rarely narrowly flask-shaped, pear-shaped or globular), more or less narrowed towards the apex, 8–25 by 5–20 mm; stone with c. 5(–10) ridges. *Seeds* curved, with curved embryo.

Distr. Throughout *Malesia*, except New Guinea.

KEY TO THE VARIETIES

1. Twigs mostly glabrous. Leaves 7–23 cm long. Fruit 8–15(–20) by 5–10 mm.

a. var. *odoratissima*

1. Twigs mostly patently pilose, pubescent or tomentose. Leaves 15–27 cm long. Fruit 17–25 by 12–20 mm b. var. *wenzelii*

a. var. *odoratissima*. — Cf. NOOT. Leid. Bot. Ser. 1 (1975) 247. — *Dicalyx odoratissimus* BL. Bijdr. (1826) 1116. — *Dicalyx aluminosus* (non LOUR.) BL. l.c. 1117, p.p. — *S. ciliata* PRESL, Rel. Haenk. 2 (1831) 61; F.-VILL. Nov. App. (1880) 127. — *S. patens* PRESL, Rel. Haenk. 2 (1831) 61; F.-VILL. Nov. App. (1880) 127; BRAND, Pfl. R. Heft 6 (1901) 34, incl. var. *ciliata* BRAND, l.c. 35; Philip. J. Sc. 3 (1908) Bot. 4, incl. f. *ciliata* BRAND, l.c. 5 et f. *elmeri* BRAND, l.c. 4; MERR. En. Philip. 3 (1923) 301. — *S. repandula* MIQ. Fl. Ind. Bat. Suppl. 1 (1861) 474. — *S. racemosa* (non ROXB.) F.-VILL. Nov. App. (1880) 127. — *S. spicata* (non ROXB.) F.-VILL. l.c. 127; VIDAL, Synopsis Atlas (1883) t. 64. — *S. vilarii* VIDAL, Rev. Pl. Vasc. Filip. (1886) 178, excl. syn. *Guettarda polyandra* BLANCO, nom. illeg. — *S. pseudospicata* VIDAL, l.c. 179. — *Pygeum grandiflorum* KING, J. As. Soc. Beng. 66, ii (1897) 228; cf. KALKMAN, Blumea 13 (1965) 107. — *S. aluminosa* BRAND, Pfl. R. Heft 6 (1901) 35. — *S. polyandra* sens. BRAND, l.c. 36, quoad descr. et syn. Vidal. — *S. floridissima* BRAND, l.c. 35; Philip. J. Sc. 3 (1908) Bot. 5; *ibid.*, 7 (1912) Bot. 32; MERR. En. Philip. 3 (1923) 298. — *S. elmeri* BRAND in PERKINS, Fragm. Fl. Philip. (1904) 36. — *S. pulverulenta* KING & GAMBLE, J. As. Soc. Beng. 74, ii (1906) 234; RIDL. Fl. Mal. Pen. 2 (1923) 300; BURK. Dict. 2 (1935) 112. — *S. floridissima* BRAND var. *serrata* BRAND, Philip. J. Sc. 4 (1909) Bot. 108. — *S. pulgarensis* ELMER, Leaflet. Philip. Bot. 5 (1913) 1841; MERR. En. Philip. 3 (1923) 302. — *S. apoensis* ELMER, Leaflet. Philip. Bot. 7 (1914) 2319; MERR. En. Philip. 3 (1923) 297. — *S. megabotrys* MERR. Philip. J. Sc. 9 (1914) Bot. 383; En. Philip. 3 (1923) 300. — *S. dagamensis* BRAND in Fedde, Rep. 14 (1916) 324; MERR. En. Philip. 3 (1923) 298. — *S. salix* BRAND in Fedde, Rep. 14 (1916) 325; MERR. En. Philip. 3 (1923) 302. — *S. acuminatissima* MERR. Philip. J. Sc. 11 (June 1916) Bot. 31; En. Philip. 3 (1923) 296. — *Pygeum viride* BAKER f. J. Bot. 62 (1924) Suppl. 34; cf. KALKMAN, Blumea 13 (1965) 107. — *S. bulusanensis* ELMER, Leaflet. Philip. Bot. 10 (1939) 3792, nom. illeg., angl. — *S. verdifolia* ELMER, l.c. 3793, nom. illeg., angl. — Fig. 7.

Tree up to 30 m, 50 cm \varnothing . Twigs, petioles and underside of leaves mostly glabrous, sometimes however tomentellous, tomentose, or pubescent. Leaves 7–23 by 2–12 cm, in watersprouts up to 40 cm. Fruit with thin, fleshy mesocarp, 8–15 by 5–10 mm, ovoid, or up to 20 mm, flask-shaped. The stone with low ridges.

Distr. Throughout *Malesia*, except New Guinea.

Ecol. Primary and secondary rain-forest, not rarely along river-banks, on sandy river alluvium, in Borneo also on brown sandy soils, black soils, loam and sandstone, from sea-level to 2500 m. Fl. Febr.–Nov., fr. Aug.–March. Flowers are noted to be fragrant.

Uses. Dayak people extract salt from wood ash.

As in other species the bark is used for dyeing purposes and HEYNE l.c. even says that for the purpose of obtaining bark and leaves the species is planted by the Sundanese at Tjiamis.

The tree is mainly useful for the inner bark which is commonly sold in the medicinal market in West Java as *kayu* or *kulit sēriawan*. Decoctions are used against sprue-like diseases; also pounded bark is applied to the gums and young leaves are sometimes eaten or applied externally on mouth and nose. *Obat sēriawan* is even officially recognized in the Dutch pharmacopeia.

Vern. Sumatra: *sarigitung*, Karo, *tjirupago uding*, Simalur; Java: *ki njatu*, *ki sariawan*, *ki sēriawan*, S; Borneo: *lisang*, Kinabatangan, Dusun lang., *margaram*, Sangkulirang I.; Bali: *udu*; Talaud: *labah*.

b. var. wenzelii (MERR.) NOOT. Leid. Bot. Ser. 1 (1975) 248. — *S. wenzelii* MERR. Philip. J. Sc. 10 (1915) Bot. 282; En. Philip. 3 (1923) 302. — *S. trichophlebia* MERR. Un. Cal. Publ. Bot. 15 (1929) 248. — Fig. 7.

Tree up to 26 m, 50 cm \varnothing . Twigs usually patently pilose, pubescent or tomentose. Leaves mostly densely pubescent, 15–27 by 12–20 cm; ridges on the stone up to 4 mm.

Distr. *Malesia*: Borneo (Sarawak and Kalimantan), Philippines (Leyte, once).

Ecol. Primary and secondary rain-forest in the lowland and hills in a variety of conditions: sandy ridges and slopes, calcareous loam, dark red soil, and black soil, near streams. *Fl.* (March) June–Dec., *fr.* (Febr.–May) July. Obviously mature fruits are often noted pale green or white.

Note. Size and shape of leaves are very variable in *S. odoratissima*; *var. wenzelii* possesses the larger and most hairy leaves. The flowers are exactly matching those of *var. odoratissima* and with collections without fruit it is not always possible to decide to which variety they belong.

42. Symplocos ophirensis CLARKE, Fl. Br. Ind. 3 (1882) 579; K. & G. J. As. Soc. Beng. 74, ii (1906) 243; RIDL. Fl. Mal. Pen. 2 (1923) 305; NOOT. Leid. Bot. Ser. 1 (1975) 249, f. 4a–e. — *Eugeniodes ophirens* O. K. Rev. Gen. Pl. 2 (1891) 975. — Fig. 4a–e.

For further synonyms see under the *infraspecific taxa*.

Shrub or tree to 18 m high and 50 cm \varnothing . Twigs glabrous, or sometimes the youngest parts appressedly pubescent. Leaves glabrous, except sometimes the very youngest, cuneate or rounded to acuminate, with cuneate base and entire, glandular crenulate to denticulate or serrate margin, elliptic to ovate or obovate, 5–22 by 1½–7 cm; nerves 4–13(–16) pairs, anastomosing or meeting in an intramarginal vein; petiole 2–10(–20) mm. Flowers in a short raceme, a 3–5-branched panicle of racemes or a spike of 1–3(–6 in Sumatra) cm, rarely only 1–3 flowers together; axis appressedly pubescent to minutely puberulous or nearly glabrous. Bracts and bracteoles caducous or persistent, with same indument as axis, ½–1½(–3) mm and slightly shorter than that respectively. Calyx with same indument as ovary or less hairy, ½–1 (2½–3 in *ssp. cumingiana* *var. pachyphylla*) mm long. Corolla 2–5 mm. Stamens 20–60, but more than 75 in *var. pachyphylla*. Disk glabrous to shortly pilose, 5-glandular. Ovary mostly with same indument as inflorescence axis, or densely appressedly pubescent, rarely glabrous, c. 1½ mm high (2½ mm in

var. pachyphylla); style glabrous to pilose, 3–5(–8) mm. Fruit ampulliform, with long neck, to ovoid, rarely ellipsoid or cylindrical; stone with coarse surface, low lengthwise ridges, or high, interrupted ridges and then with hollow base, filled with fleshy mesocarp. Seed 1, embryo obscurely S-shaped, curved with an angle of c. 90° \pm halfway its length, or twice screw-like curved.

Distr. *Malesia*: Central West Sumatra (incl. Lingga Is.), Malay Peninsula, Borneo, Celebes, and throughout the Philippines.

KEY TO THE INFRASPECIFIC TAXA

1. Twigs densely appressedly pubescent or tomentose . . . 1. *ssp. ophirensis* **b. var. densireticulata**
1. Twigs glabrous or sparsely fine-hairy.
2. Fruit ampulliform, with long neck. Ovary 1½ mm high. Calyx lobes c. ½ mm long. Corolla 2–3 mm. Disk globose or annular, shortly pilose . . . 2. *ssp. perakensis*
3. Terminal buds glabrous. Secondary veins forming a rather coarse reticulation with the slightly less prominent veins. Inflorescence a many-flowered panicle of racemes, 1–4 cm long. Style shortly pilose for its whole length. **c. var. perakensis**
3. Terminal buds glabrous. Secondary veins prominent, forming a fine reticulation with the faintly prominent tertiary veins. Inflorescence a 1–3-flowered raceme, up to 1 cm. Style pilose only towards its base. **d. var. lingaensis**
3. Terminal buds pubescent. Secondary and tertiary veins much prominent, forming a fine reticulation with the often also prominent quaternary veins. Style glabrous. **e. var. sumatrana**
2. Fruit ovoid, ellipsoid, or cylindrical. Ovary 1½(–2½) mm high. Calyx lobes ½–1(–1½) mm long. Corolla 3–5 mm. Disk 5-glandular, glabrous or sparsely hairy.
4. Fruit ovoid to cylindrical; stone with shallow lengthwise grooves. Seed ovoid, with small, nearly straight embryo. Disk sparsely hairy. Reticulation beneath very dense. 1. *ssp. ophirensis* **a. var. ophirensis**
4. Fruit ovoid, ellipsoid, or rarely cylindrical; stone with high, interrupted ridges. Seeds ovoid to horse-shoe-shaped, embryo curved, or twice screw-like curved. Disk glabrous, rarely with some hairs. Reticulation beneath either very fine or coarse . . . 3. *ssp. cumingiana*
5. Inflorescence a raceme. Ovary 1½ mm. Calyx lobes ½–1 mm. Corolla 3–4½ mm. Stamens 20–60 **f. var. cumingiana**
5. Inflorescence a spike. Ovary 2½ mm. Calyx lobes c. 1½ mm. Corolla c. 5 mm. Stamens more than 75 **g. var. pachyphylla**

1. *ssp. ophirensis*. — Cf. NOOT. Leid. Bot. Ser. 1 (1975) 252. — *S. ophirensis* CLARKE, Fl. Br. Ind. 3 (1882) 579.

For the description see the species.

a. var. ophirensis. — Fig. 7.

Shrub 1½ m, or small tree to 6 m. Leaves acuminate or rounded, (narrowly) elliptic, 5½–9½ (–11½) by 1½–4½(–6) cm; nerves 5–6 pairs,

meeting in a looped intramarginal vein; petiole only with faint ridges towards the blade. Racemes up to 10 mm, from the axils of the upper leaves or from wood. Bracts caducous or persistent. Pedicels 1–3 mm. Calyx lobes $1\frac{1}{2}$ –1 mm. Corolla 3–5 mm. Stamens 25–60. Disk usually sparsely hairy. Ovary $1\frac{1}{2}$ mm high; style glabrous, $3\frac{1}{2}$ –5 mm. Fruit ovoid to cylindrical, 6–12 by 4–5 mm. Seed ovoid, with small, nearly straight embryo.

Distr. *Malesia*: Malay Peninsula (Perak, Selangor, Johore).

Ecol. Montane forest, bush-like, on granite, 1200–1500 m. *Fl.* July–Sept., *fr.* Aug. Young leaves black purple.

b. var. *densireticulata* NOOT. *Leid. Bot. Ser. 1* (1975) 252.

Small, bushy treelet, 2–4 m. Twigs (appressedly) pubescent to tomentose. Leaves cuneate to acuminate with cuneate to cordate base, $3\frac{1}{2}$ –11 by $1\frac{1}{2}$ –4 $\frac{1}{2}$ cm; nerves 6–9 pairs, anastomosing or meeting in an intramarginal vein; petiole 2–9 mm. Flowers in a short raceme to c. 3 cm; axis pubescent. Bracts and bracteoles pubescent, soon caducous, 2 and 1 mm long respectively. Calyx pubescent, 1– $1\frac{1}{2}$ mm long, the lobes \pm triangular, c. 1 mm. Corolla 2–2 $\frac{1}{2}$ mm. Stamens delicate, c. 40. Disk inconspicuous, pilose. Ovary pubescent, 1 mm high; style glabrous, c. 2 mm. Fruit pubescent, ellipsoid, 5–8 by 4–5 mm; stone smooth. Seed not seen.

Distr. *Malesia*: Malay Peninsula (Pahang: Cameron Highlands) and S. Celebes, in both areas 2 collections each.

Ecol. Montane forest, 1400–2500 m. *Fl.* Sept.

2. ssp. *perakensis* (K. & G.) NOOT. *Leid. Bot. Ser. 1* (1975) 254. — *S. perakensis* KING & GAMBLE, *J. As. Soc. Beng.* 74, ii (1906) 241; RIDL. *Fl. Mal. Pen.* 2 (1923) 304; BURK. *Dict.* (1935) 2114. — *S. caudata* (non WALL. ex G. DON) RIDL. *Fl. Mal. Pen.* 2 (1923) 304.

Tree to 18 m high and 50 cm \varnothing . Leaves faintly acuminate to caudate with cuneate base, (narrowly) elliptic, 5–12 by 2–4 $\frac{1}{2}$ cm; nerves 4–7 pairs, except in *var. sumatrana* meeting in a looped intramarginal vein; petiole 3–9 mm, not winged. Flowers in a (basally) 3–5-branched very slender panicle of racemes, a raceme, or in *var. lingaensis* only 1–3 flowers in each inflorescence. Bracts and bracteoles persistent, minute. Pedicels 1–4 mm. Calyx divided into semiorbicular c. $\frac{1}{2}$ mm long lobes. Corolla 2–3 mm. Stamens 30–50. Disk shortly pilose. Ovary $1\frac{1}{2}$ –1 mm high; style pilose to glabrous. Fruit ampulliform, c. 7 by 5 mm, with long beak; stone with coarse surface, the inner wall of the stone following the grooved surface of the deeply ruminate cerebrum-like seed; embryo curved with an angle of not yet 90°.

Distr. *Malesia*: Sumatra, Malay Peninsula, and the Philippines.

c. var. *perakensis*. — *Cf.* NOOT. *Leid. Bot. Ser. 1* (1975) 255, f. 4a–c. — *S. fragrans* ELMER, *Leaf. Philip. Bot.* 2 (1908) 508; BRAND, *Philip. J. Sc.* 7 (1912) Bot. 33; MERR. *En. Philip.* 3 (1923) 299. — **Fig. 4a–c, 7.**

Leaves 5–11 by 2–4 $\frac{1}{2}$ cm; petiole 3–6 mm. Flowers in a many-flowered panicle of racemes of

1–4 cm. Calyx and ovary appressedly pubescent; style shortly pilose for its whole length.

Distr. *Malesia*: Malay Peninsula and the Philippines (Negros, once).

Ecol. Primary lowland and montane forest, hillsides, bamboo forest, 60–1500 m. *Fl.* April–July, Sept., *fr.* Nov.

d. var. *lingaensis* NOOT. *Leid. Bot. Ser. 1* (1975) 255. Leaves narrowly elliptic with caudate apex, 7–12 by 2–3 $\frac{1}{2}$ cm; petiole c. 5 mm. Flowers in a 1–3-flowered raceme to 1 cm. Calyx and ovary minutely puberulous; style pilose only towards its base. Fruit unknown.

Distr. *Malesia*: Sumatra (Lingga Arch.). Only known from the type.

e. var. *sumatrana* NOOT. *Leid. Bot. Ser. 1* (1975) 256.

Leaves faintly acuminate, narrowly elliptic, 6–10 by 2–3 cm; nerves 4–5 pairs; petiole 4–9 mm. Flowers in a lax panicle or raceme of $1\frac{1}{2}$ –6 cm. Calyx and ovary minutely appressedly pubescent; style glabrous. Fruit not known.

Distr. *Malesia*: Central West Sumatra.

Ecol. Montane forest, 900–1300 m.

3. ssp. *cumingiana* (BRAND) NOOT. *Leid. Bot. Ser. 1* (1975) 253. — *S. cumingiana* BRAND, *Pfl. R. Heft* 6 (1901) 58.

Shrub or small tree to 6 m. Leaves \pm elliptic, 6–22 by 3–7 cm; nerves 6–13(–16) pairs; petiole 1–10(–20) mm, narrowly winged, except to its very base. Flowers in a 3(–5) cm long often branched raceme or spike. Pedicels 0–3 mm. Calyx $1\frac{1}{2}$ –1(– $1\frac{1}{2}$) mm long. Corolla 3–5 mm. Disk 5-glandular, glabrous, rarely with some hairs. Ovary $1\frac{1}{2}$ –(2 $\frac{1}{2}$) mm high. Fruit ovoid, ellipsoid or rarely cylindrical, 5–12 by 3–8 mm; stone with high, interrupted ridges which often protrude from the base, enclosing some fleshy mesocarp. Seed ovoid to horse-shoe-shaped, embryo curved with an angle of about 90° to twice screw-like curved.

Distr. *Malesia*: Borneo, Philippines and Celebes.

f. var. *cumingiana*. — *Cf.* NOOT. *Leid. Bot. Ser. 1* (1975) 253, f. 4d–e, pl. 20a–e. — *S. cumingiana* BRAND, *Pfl. R. Heft* 6 (1901) 58; *Philip. J. Sc.* 3 (1908) Bot. 8; *ibid.* 7 (1912) Bot. 34; MERR. *En. Philip.* 3 (1923) 297; H. HEINE, *Pfl. Samml. Clemens Kinabalu* (1953) 87. — *S. curtiflora* ELMER, *Leaf. Philip. Bot.* 2 (1908) 509; MERR. *En. Philip.* 3 (1923) 298. — *S. angularis* ELMER, *Leaf. Philip. Bot.* 2 (1908) 510. — *S. purpurascens* BRAND, *Philip. J. Sc.* 7 (1912) Bot. 33; MERR. *En. Philip.* 3 (1923) 302. — *S. minutiflora* ELMER, *Leaf. Philip. Bot.* 7 (1914) 2320; MERR. *En. Philip.* 3 (1923) 300. — *S. agusanensis* ELMER, *Leaf. Philip. Bot.* 7 (1914) 2321. — *S. elliptifolia* MERR. *Philip. J. Sc.* 12 (1917) Bot. 292; *En. Philip.* 3 (1923) 298. — *S. brachybotrys* MERR. *Philip. J. Sc.* 14 (1919) 447, *non* MERR. 1917; *En. Philip.* 3 (1923) 297. — *S. ilocana* MERR. *Philip. J. Sc.* 35 (1928) 7. — **Fig. 4d–e, 7.**

Shrub $1\frac{1}{2}$ m or small tree to 12 m, once even 30 m and 50 cm \varnothing . Leaves \pm elliptic, 6–18 by 3–7 cm; nerves 6–13(–16) pairs, usually meeting in a looped intramarginal vein; petiole 3–10(–15)

mm. Racemes to 3(–5) cm long. Bracts and bracteoles usually very small, caducous or persistent. Pedicels 1–3 mm. Calyx $1\frac{1}{2}$ –1 mm, pubescent. Corolla 3–4 $\frac{1}{2}$ mm. Stamens 20–60. Ovary 1 $\frac{1}{2}$ mm high. Fruit 5–12 by 3–7 mm, ripe purple-blue.

Distr. *Malesia*: Borneo, Philippines, Celebes.

Ecol. Mostly in the mountain forest, on hillsides in oak-*Podocarpus* forest, largely between 1000 and 3000 m, but on Mt Kinabalu once found as high as 3700 m (sterile), and once collected in lowland Dipterocarp forest at 300 m in the Sierra Madre Mts (Luzon), a very common species in the Philippines. Flowers (once) noted to be faintly fragrant. Fl. May–Dec., fr. March–Oct.

g. var. *pachyphylla* (MERR.) NOOT. Leid. Bot. Ser. 1 (1975) 254. — *S. pachyphylla* MERR. Philip. J. Sc. 10 (1915) Bot. 283. — Fig. 7.

Small tree, 6 m. Leaves 10–20 by 6–8 $\frac{1}{2}$ cm; nerves c. 10 pairs; petiole 10–20 mm. Flowers in a spike. Bracts and bracteoles appressedly pubescent, 2 $\frac{1}{2}$ and 3 mm long respectively. Calyx densely appressedly pubescent, divided into c. 1 $\frac{1}{2}$ mm long lobes. Corolla c. 5 mm. Stamens more than 75, up to 9 mm. Disk glabrous, 5-glandular. Ovary glabrous, 2 $\frac{1}{4}$ mm high; style glabrous, c. 8 mm. Fruit ovoid, c. 10 by 6–8 mm, the stone as in var. *cumingiana*, but several ridges totally lacking in the upper half, c. 7 by 5–6 mm. Seed ovoid or curved, and then as the embryo with an angle of about 90° beneath the middle.

Distr. *Malesia*: Philippines (Leyte and Mindanao), 2 collections.

Ecol. Hill forest, c. 500 m. Fl. Sept.

43. *Symplocos paucistaminea* F.v.M. & F. M. BAILEY, 3rd Suppl. Syn. Queensl. Fl. (1890) 46; F. M. BAILEY, Queensl. Fl. 3 (1900) 967; NOOT. Leid. Bot. Ser. 1 (1975) 262. — Fig. 7.

Tree 18 m, 45 cm \varnothing . Twigs densely spreadingly pubescent to tomentose. Leaves acuminate, with acute to rounded base and dentate margin, sparsely pubescent above and beneath, elliptic to obovate, 8–20 by 3–8 cm; nerves 7–12 pairs, meeting in a looped intramarginal vein; petiole 5–10 mm. Flowers in a basally branched spike to 5 cm long, becoming longer in fruit; axis sparsely brown hairy. Bracts and bracteoles persistent, spreadingly hairy, c. 2 and c. 1 $\frac{1}{2}$ mm respectively. Calyx divided into glabrous c. 1 mm long lobes, the lobes tomentose. Corolla c. 2 $\frac{1}{2}$ mm. Stamens c. 10 to 60. Disk glabrous or pilose. Ovary glabrous, c. $\frac{3}{4}$ mm high; style glabrous, c. 1 $\frac{1}{2}$ mm. Fruit ampulliform, c. 6 by 4 mm, stone ampulliform with globose, lengthwise grooved belly and narrow cylindrical neck, 1-celled. Seed 1, filling the whole stone, with the embryo twice curved.

Distr. Queensland and *Malesia* (New Guinea: Milne Bay Distr.: Mt Suckling, two collections).

Ecol. Lowland rain-forest at 360 m. Fl. July.

44. *Symplocos polyandra* (BLANCO) BRAND, Pfl. R. Heft 6 (1901) 436, *quoad syn. Blanco, excl. descr. et stirp.*; MERR. Sp. Blanc. (1918) 304; En. Philip. 3 (1923) 301; STEEN. Bull. Bot. Gard. Btzg III, 12 (1932) 170, f. 5; NOOT. Leid. Bot. Ser. 1 (1975) 264. — *Guettarda polyandra* BLANCO, Fl. Filip. ed. 2 (1845) 500; ed. 3 (1879) 126. — *Carlea oblongi-*

folia PRESL, Epim. Bot. (1851) 216. — *Baranda angatensis* LLANOS, Mem. Acad. Cienc. Madrid 3, 2 (1857) 502. — *S. oblongifolia* ROLFE, J. Bot. 23 (1885) 214; VIDAL, Phan. Cuming. Philip. (1885) 124; Rev. Pl. Vasc. Filip. (1886) 178; BRAND, Pfl. R. Heft 6 (1901) 55; HALL. f. Beih. Bot. Centralbl. 39 B (1921) 94. — *S. superba* BRAND, Pfl. R. Heft 6 (1901) 55. — Fig. 7.

Tree up to 30 m, 50 cm \varnothing , rarely a shrub. Bark dark, cracked. Twigs puberulous, glabrescent, tapering off towards the apex, thick, at least 5 mm \varnothing beneath the leaves and there usually with many pulvinate leaf-scars. Leaves crowded towards the end of the twigs, rounded or cuneate-obtuse at the apex, with cuneate, attenuate base and entire, revolute margin, glabrous (except in innovations and then puberulous), narrowly elliptic to obovate, 9–22 by 2 $\frac{1}{2}$ –7(–9) cm; nerves 11–15 pairs; petiole 2–4 cm. Many spikes from old wood beneath the leaves, axis densely rusty appressedly puberulous, glabrescent, 4–15 cm long. Bracts and bracteoles with same indument, persistent under the fruit, 1 $\frac{1}{2}$ –2 mm long. Calyx with same indument, becoming glabrous towards the apex, 2–3 mm, the lobes c. 2 mm long. Corolla 8–10 mm. Stamens 50 to more than 100. Disk glabrous, annular, and then surrounding a lower, rarely shortly pilose receptacle, or low pulvinate, only surrounding the glabrous, 7–9 mm long style. Ovary with same indument as calyx, c. 2 mm high. Fruit ellipsoid, c. 10 by 7 mm in vivo; stone rather smooth, with few shallow lengthwise grooves, 8–10 by 4–5 mm (s.s. the whole fruit as big as the stone), 3-celled. Seed 1 in each cell with straight embryo.

Distr. *Malesia*: Borneo and adjacent islands (Natuna, Banka, Billiton, Karimata, St. Barbe), Philippines (throughout), and SW. Celebes (Makassar: Boleh Angien, once).

Ecol. Secondary and primary forest, almost always on sandstone, granite, kerangas, sandy flats, more rarely on sandy loam, at low altitude, below c. 300 m, once found in montane forest (Luzon: Sierra Madre) at 1000–1100 m in low, mixed, primary rain-forest (JACOBS 7840). Fl. Sept.–March, fr. Febr.–June (July–Oct.). The flowers are faintly fragrant, especially at night.

Vern. *Bungur*, *dutat*, Banka; *sudjeng*, Natuna; Borneo: *merbryot*, Sarawak, *beluno-beluno*, *salam-buno*, *temasuk jantan*, Sandakan; Philippines: *ditáman*, *rapo-rápo*, Tag., *balakbák*, *balakbákan*, *bangkunai*, *mankónai*, P.Bis., *buli-buli*, *malabuli*, *ribuli*, Pang., *dilangi-báka*, Sbl.

45. *Symplocos pulvinata* NOOT. Leid. Bot. Ser. 1 (1975) 269. — Fig. 7.

Sparsely foliated tree, 12–18 m high. Twigs thick, at least 5 mm. Leaves coriaceous, glabrous, acute or faintly acuminate with cuneate base and glandular crenate or dentate margin, obovate, 12–21 by 4 $\frac{1}{2}$ –10 $\frac{1}{2}$ cm; nerves 8–12 pairs; petiole stout, 1 $\frac{1}{2}$ –2 $\frac{1}{2}$ cm. Spike glabrous, c. 3 cm. Bracts and bracteoles probably persistent, glabrous, 5–7 and c. 4 mm long respectively (older flowers often fallen including bracts and bracteoles, leaving conspicuous pulvinate light coloured scars on the dark axis). Calyx glabrous, c. 3 mm, divided in 5, 2–2 $\frac{1}{2}$ mm long lobes. In some flowers corolla and stamens absent or obsolete, in other flowers

corolla 5 mm, 3(4)-lobed and stamens 20–35. Disk glabrous. Ovary glabrous, oblique, 1–1½ mm at one, c. 2 mm at the other side; style glabrous, 6 mm. Fruit ovoid, deeply violet, c. 13 by 6–8 mm; stone with rather high lengthwise ridges in the basal and low ridges in the apical half, in the middle a deep transverse groove, 1-celled. Seed 1, uncinately curved towards the base with curved embryo.

Distr. *Malesia*: East New Guinea (Koitaki and Normanby I.), 2 collections.

Ecol. Under open canopy of tall forest, 450–825 m. Fl. Febr.

46. *Symplocos pyriflora* RIDL. J. Fed. Mal. St. Mus. 6 (1915) 159; Fl. Mal. Pen. 2 (1923) 307. — *S. bakeri* SYMINGTON, J. Mal. Br. R. As. Soc. 14 (1936) 356, t. xx. — Fig. 7.

Shrub or small to medium-sized tree. Twigs often stout, glabrous. Leaves glabrous, mostly faintly acuminate with cuneate or rounded base and undulate to crenate margin, elliptic, 5–15 by 2–2¾ cm; nerves 9–14 pairs, meeting in an intramarginal vein 2–4 mm from the margin; petiole stout, 3–10 mm. Flowers in a subterminal, rarely terminal, raceme or panicle of racemes; axis pubescent to glabrous. Bracts and bracteoles glabrous, soon caducous, c. 8 and c. 5 mm long respectively. Pedicel at most 3 mm. Calyx glabrous, 3–5 mm, sometimes becoming symmetric by tearing; lobes 2–3 mm, becoming longer by tearing apart. Corolla 8–10 mm. Stamens c. 100 or more. Disk 5-glandular, included the conical style base glabrous or soft hairy. Ovary glabrous, 1½–2 mm high; style glabrous, c. 5 mm. Fruit ellipsoid, c. 15 by 8 mm; stone smooth or with faint ridges, 1-celled. Seeds not seen, but probably with straight embryo.

Distr. *Malesia*: Malay Peninsula (Pahang: G. Tahan; Kuantan: G. Tapis), two collections.

Ecol. Montane rain-forest, 1400–1650 m. Fl. June.

Note. Closely allied to *S. nivea*, see there.

47. *Symplocos robinsonii* RIDL. J. Fed. Mal. St. Mus. 8 (1917) 60; NOOT. Leid. Bot. Ser. 1 (1975) 276.

Twigs tomentose, dark brown pubescent or (sparsely) appressedly pubescent or puberulous, glabrescent. Leaves sparsely long pubescent, appressedly fine dark-pilose or sparsely appressedly minutely pilose, glabrescent beneath, acute or acuminate with acute base and dentate, denticulate or crenulate margin, narrowly to broadly elliptic, 3–9½ by 1½–4 cm; nerves 7–14 pairs. Flowers in an often branched raceme to 1, 2 or 4 cm; axis pubescent or appressedly puberulous. Bracts and bracteoles caducous, with same indument as axis, 1–2 and ¾ to 1½ mm respectively. Pedicel to 2 or 3(4) mm long. Calyx pubescent to puberulous, often less hairy than ovary, 1–2 mm, the lobes ½–1½ mm. Corolla 4–5 mm. Stamens 25–55. Disk with some hairs or shortly pilose, often the indument hardly visible. Ovary with same indument as calyx or more hairy; style glabrous, or the base shortly pilose. Fruit ellipsoid, 7–10 by 3–6 mm; stone inconspicuously lengthwise grooved, 3-celled. Seeds 1–3, straight with straight embryo.

Distr. *Malesia*: Sumatra.

KEY TO THE VARIETIES

1. Twigs tomentose a. var. *robinsonii*
1. Twigs not tomentose.
 2. Inflorescence to 4 cm long. Leaves 3–6 by 2–4 cm (index 1¼–2¼) b. var. *latifolia*
 2. Inflorescence 1–2 cm long.
 3. Twigs densely dark-brown pubescent. Leaves 4–6½ by 1½–3½ cm (index 1¾–2¾) c. var. *pilosa*
 3. Twigs sparsely appressed-pubescent or puberulous. Leaves 5–9½ by 2–3 cm (index 2¼–3¼) d. var. *angustifolia*

a. var. *robinsonii*. — Cf. NOOT. Leid. Bot. Ser. 1 (1975) 277. — Fig. 7.

Twigs tomentose. Leaves sparsely long-pubescent, especially on midrib and nerves beneath, ± elliptic, 4½–9 by 2–3¾ cm; nerves 7–9 pairs; petiole 7–10 mm. Raceme to 2 cm, axis rusty pubescent. Bracts and bracteoles appressedly pubescent, 1½ and 1 mm long respectively. Pedicel to 3 mm. Calyx appressedly pubescent, c. 1 mm, the ± ovate lobes ¾–1 mm long. Corolla c. 4 mm. Stamens 25–40. Disk with some hairs. Ovary appressedly pubescent, c. 1½ mm high; style with conical base, glabrous. Fruit 7 by 3 mm; stone 3-celled.

Distr. *Malesia*: Sumatra (Westcoast: G. Kerintji).

Ecol. *Gleichenia* woodland in mountain forest, 2200–2500 m. Fl. May, Aug.

b. var. *latifolia* NOOT. Leid. Bot. Ser. 1 (1975) 277. — Fig. 7.

Treetlet 6 m. Twigs (sparsely) appressedly pubescent, glabrescent. Leaves sparsely minutely appressedly pilose beneath, especially on midrib and nerves, or glabrous, shortly acuminate, 3–6 by 2–4 cm; nerves 7–8 pairs; petiole 4–7 mm. Raceme branched, to 4 cm; axis (sparsely) appressedly puberulous. Bracts and bracteoles ovate, 1–1½ mm. Pedicel to 3(4) mm. Calyx sparsely appressedly puberulous, 1¼–2 mm long, the ± semi-orbicular lobes 1–1¼ mm long. Corolla c. 5 mm. Stamens 35–55. Disk with the conical style base pilose. Ovary with same indument as calyx, c. 1¼ mm high; style glabrous, c. 4 mm. Fruit c. 10 by 6 mm, blue-black. Seeds 1–3.

Distr. *Malesia*: northern half of Sumatra (Gajo Lands: G. Losir; Westcoast: G. Kerintji).

Ecol. In dense ericoid shrub-forest, 2000–3000 (–3400) m. Fl. May–Aug. Flowers scentless.

c. var. *pilosa* NOOT. Leid. Bot. Ser. 1 (1975) 278.

Twigs densely dark brown pubescent. Leaves appressedly fine dark pilose beneath, especially on midrib and nerves, acute to acuminate, ± elliptic, 4–6½ by 1½–3½ cm; nerves 7–10 pairs; petiole 5–7 mm. Raceme to 1 cm; axis appressedly brown pubescent. Bracts and bracteoles with same indument, 1½–2 and 1–1½ mm respectively. Pedicel to 2 mm. Calyx sparsely fine puberulous, c. 1½ mm, the lobes semi-elliptic to ovate, c. 1 mm long. Corolla 4–5 mm. Stamens 30–45. Disk minutely pilose, hairs sometimes very inconspicuous. Ovary appressedly fine puberulous, 1¼–1½ mm high; style glabrous, 4–5 mm.

Distr. *Malesia*: Sumatra (Westcoast: G. Merapi and G. Singalang).

Ecol. Subalpine mountain forest, between lava boulders, 2500–2800 m. *Fl.* May–June.

d. var. *angustifolia* NOOT. *Leid. Bot. Ser.* 1 (1975) 278.

Twigs sparsely appressedly pubescent or puberulous. Leaves sparsely appressedly minutely pilose beneath, acuminate, 5–9½ by 2–3 cm; nerves 9–14 pairs; petiole 5–12 mm. Raceme to 2 cm; axis minutely appressedly puberulous. Bracts and bracteoles with same indument, ovate, c. 1 and ¾ mm respectively. Pedicel to 3 mm. Calyx less hairy than ovary, c. 1 mm long, the lobes ovate, ½–¾ mm. Corolla c. 4 mm. Stamens c. 35. Disk minutely pilose. Style glabrous.

Distr. *Malesia*: Sumatra (Westcoast: G. Ophir = G. Talakmau).

Ecol. Subalpine mountain forest, 1900–2700 m. *Fl.* May.

48. *Symplocos rubiginosa* WALL. (Cat. 1831, n. 4432, *nomen*) ex DC. *Prod.* 8 (1844) 257; *Miq.* *Fl. Ind. Bat.* 1, 2 (1859) 466; CLARKE, *Fl. Br. Ind.* 3 (1882) 580; BRAND, *Pfl. R. Heft* 6 (1901) 53; K. & G. J. *As. Soc. Beng.* 74, ii (1906) 247; RIDL. *Fl. Mal. Pen.* 2 (1923) 306; NOOT. *Leid. Bot. Ser.* 1 (1975) 279. — *Lodhra rubiginosa* MIERS, *J. Linn. Soc. Bot.* 17 (1879) 299. — Fig. 7.

Shrub, or tree to 30 m high and 50 cm Ø. Twigs tomentose, pubescent, tomentellous or glabrous, rather thick (3–5 mm). Leaves sparsely appressedly pilose to more or less densely patently soft-villous beneath, especially on midrib and nerves, usually abruptly acuminate with cuneate base and finely to rather coarsely dentate margin, narrowly elliptic to obovate, 15–45 by 5¾–17 cm; nerves 12–17 pairs; petiole thickened, 10–25 mm. Flowers in a spike from wood beneath or between the leaves; in bud the inflorescence has the appearance of a short cone; axis pubescent to tomentellous, 1–5(–8) cm. Bracts and bracteoles caducous as soon as the flower matures, ovate, boat-shaped, densely silky-pubescent, 3–5 and 2–3 mm respectively. Calyx appressedly puberulous to silky pubescent, often symmetrically torn, 1½–3 mm, the lobes ½–2 mm. Corolla sparsely (minutely) stiff hairy towards the outer base, 4–5 mm. Stamens 60–100. Disk glabrous or sparsely pilose. Ovary pubescent to tomentellous or with same indument as calyx, 1–2 mm high; style glabrous or pilose, sometimes with thick conical pilose base. Fruit blue *in vivo*, ovoid to ellipsoid, sparsely short pilose to glabrous, 8–10 by 5–8 mm; stone lengthwise grooved, at one side with a deep transverse constriction at ¼ from the base. Seed 1, once or twice and then S-shaped curved due to the constriction of the stone.

Distr. *Malesia*: Sumatra, Malay Peninsula, and Borneo (rare in Kalimantan).

Ecol. Both in the lowland and in the hills, from sea-level to 1800 m, in primary and secondary mixed rain-forest, not rarely in Dipterocarp forest, along streamsides, on kerangas, in *bertam* (*Euglossona*) ridge forest. *Fl.* Oct.–Dec. (once April), fr. Jan.–Dec. Fruit remain white for a long time, then turn through red to light blue when ripe.

Uses. The wood is very hard and used for house-building (BURK. *Dict.* 1935, 2115).

Vern. Sumatra: *lempaong kantil*, Palemb.; Malaya: *pemasa*, Sakai lang.; Borneo: *smuak*, Sarawak, Land-Dayak.

49. *Symplocos salicioides* NOOT. *Leid. Bot. Ser.* 1 (1975) 280.

Shrub 2 m, with pubescent twigs. Leaves faintly acuminate to sharply acute, with cuneate to rounded base, pubescent beneath, narrowly elliptic, 3½–7 by ¾–1½ cm; nerves 6–8 pairs, rather inconspicuous, meeting in an intramarginal looped vein; petiole 3–4 mm. Spike 1-flowered. Bracts and bracteoles pubescent, 2 and 1 mm long respectively. Calyx densely pubescent, divided into 1–1¼ mm long triangular lobes. Corolla 2–2½ mm. Stamens 15–20. Disk with the conical style base softly long-hairy. Ovary with same indument as calyx, 1¼ mm high; style hairy for its lower half, c. 2 mm long. Fruit long ellipsoid, pubescent, 13 by 5 mm, only seen immature.

Distr. *Malesia*: East New Guinea (Sepik area, once).

Ecol. Lowland rain-forest, 1000 m.

50. *Symplocos sumatrana* BRAND, *Pfl. R. Heft* 6 (1901) 62; NOOT. *Leid. Bot. Ser.* 1 (1975) 283. — Fig. 7.

Treelet 3 m. Twigs densely patently red-brown long-hairy or tomentose. Leaves softly pilose beneath, acuminate with rounded base and denticulate margin, narrowly elliptic to ovate, 6–14 by 2–4 cm; nerves 7–15 pairs, meeting in a looped much prominent intramarginal vein; petiole 5–7 mm. Flowers in a spike or raceme of 2–4 cm; axis brown tomentose or spreadingly hairy. Bracts and bracteoles soon caducous, the first not seen, the latter appressedly long-hairy, c. 2½ mm long. Calyx divided into 5 appressedly pilose semi-elliptic 2 mm long lobes. Corolla c. 5 mm. Stamens 45–70. Disk pulvinate, pilose. Ovary sericeous, c. 1½ mm high; style with some hairs in the lower half, 2–5 mm. Fruit ellipsoid, hairy, c. 10 by 6 mm; stone lengthwise ribbed, 3-celled, 1, 2 or 3 cells fertile. Seed straight with straight embryo.

Distr. *Malesia*: Sumatra (Gajo Lands: Mt Kemiri; Westcoast: Mt Singalang), 2 collections.

Ecol. Ericoid, elfin and subalpine mossy forest, 2700–3000 m. *Fl.* March, June–July. Flowers fragrant.

51. *Symplocos sumuntia* BUCH.-HAM. ex D. DON, *Prod. Fl. Nepal.* (1825) 145; CLARKE, *Fl. Br. Ind.* 3 (1882) 578; NOOT. *Leid. Bot. Ser.* 1 (1975) 284, with full synonymy. — Fig. 7.

Low shrub to medium-sized tree. Twigs glabrous or nearly so, dark-coloured. Leaves glabrous, acuminate to caudate with attenuate base and glandular dentate margin, ± elliptic, 2–10 by ¾–4½ cm; nerves 5–8 pairs, meeting in an intramarginal vein; petiole 2–10 mm. Raceme few to many-flowered, 1–6 cm long; axis from nearly glabrous to pilose or pubescent. Bracts at base of pedicel, with the bracteoles soon caducous, appressedly hairy, 2–5 and ½–4 mm long respectively. Pedicel ½–13 mm. Calyx glabrous to (sparsely) appressedly hairy, divided into ½ to 1½ mm long lobes. Corolla 4–8 mm. Stamens 25–40. Disk

glabrous. *Ovary* glabrous to shortly sparsely appressedly hairy, 1–2 mm high; style glabrous, 2–11 mm. *Fruit* ovoid to ampulliform, 6–10 by 3–6 mm; stone shallowly (brain-like) grooved. *Seed* curved, embryo once or twice curved.

Distr. Continental Asia (India, Burma, Thailand, Indo-China, China, Hong Kong, Hainan, Formosa, Ryu Kyu Is., Japan, and Korea); in *Malesia*: Malay Peninsula (Pahang: Cameron Highlands and G. Tahan), 3 collections.

Ecol. Montane high forest, 1200–1500 m. *Fl.* Aug.–Oct.

52. *Symplocos trichomarginalis* NOOT. Leid. Bot. Ser. 1 (1975) 287. — Fig. 7.

Shrub 1–4 m. Twigs often zigzag, appressedly brown-pilose. *Leaves* alternate, sparsely appressedly pilose beneath, the midrib and the finely glandular-dentate recurved margin beneath conspicuously densely appressedly brown-pilose, acuminate with cuneate to rounded base, elliptic, 2–3½ by 1¼–1¾ cm; nerves 5–7 pairs; petiole 2–4 mm. *Flowers* solitary, often several brown-pilose bracts indicating the derivation from a more-flowered inflorescence, the 2 uppermost bracts 3–5 by 1–3 mm, persistent. Pedicel from twig to flower up to 1 cm. *Calyx* loosely appressedly pilose, divided into the narrowly elliptic, acute, c. 3 mm long lobes. *Corolla* c. 4 mm. *Stamens* c. 50. Disk glabrous. *Ovary* with same indument as calyx, c. 1 mm high; style glabrous, c. 5 mm. *Fruit* sparsely pilose, ellipsoid to ovoid, green to deep indigo when ripe, 8–9 by c. 4 mm; stone narrowly ovoid, muricate with shallow lengthwise grooves. *Seed* 1, embryo straight (only young seeds seen).

Distr. Malesia: Borneo (Sabah: Mt Kinabalu).

Ecol. Open places and forest edges, 1500–2400 m. *Fl.* May, fr. April.

Note. In habit similar to *S. zizyphoides*, but differing in the veins being obscure and in the long-pilose calyx with narrow triangular lobes being longer than those of that species.

53. *Symplocos tricoccata* NOOT. Leid. Bot. Ser. 1 (1975) 288. — Fig. 7.

Shrub 3 m to small tree to 10 m high, 15 cm Ø. Twigs glabrous. *Leaves* glabrous, yellowish or olive-grey or water-green, sometimes glossy beneath, acuminate, with acute base and dentate to denticulate margin, ± elliptic, 7–29 by 4–9½ cm; nerves 5–10 pairs, meeting in an intramarginal vein; petiole 5–15 mm. *Flowers* in a fascicle or very short spike; axis glabrous, to 5 mm long. Bracts and bracteoles soon caducous, c. 1½ mm. Pedicel 0–1 mm. *Calyx* glabrous or with some hairs, c. 2 mm long, the lobes 1–1¾ mm. *Corolla* 5–8 mm. *Stamens* 40 to more than 100. Disk 5-glandular, the conical style base with some hairs to softly short-pilose. *Ovary* glabrous, c. 2 mm high; style glabrous to 7 mm. *Fruit* narrowly obliquely ellipsoid, 12–16 by 4–6 mm, ± triangular in CS, 3-celled, each cell circular in CS; stone 3-lobed in CS, endocarp thin, woody. *Seed* cylindrical, with straight embryo.

Distr. Malesia: Borneo (Sarawak, Sabah, and Kalimantan).

Ecol. Lowland and montane primary rain-forest, near streams, on hillsides, in low undulating flat country, on rocky soil, also in Dipterocarp

forest, 30–2100 m. *Fl.* Aug.–Nov., Febr., fr. Febr.–June, Sept. Fruits often recorded to be whitish, through purple to blue when ripe.

Uses. In Sarawak the wood is said to be used for knife handles.

Vern. Borneo: *atup*, Sarawak, Kenyah lang.

54. *Symplocos trisepala* MERR. Philip. J. Sc. 12 (1917) Bot. 291; En. Philip. 3 (1923) 302; NOOT. Leid. Bot. Ser. 1 (1975) 289.

Twigs glabrous, but sparsely long-pilose in innovations. *Leaves* sparsely appressedly pilose on the midrib beneath, faintly acuminate, with rounded or subcordate base and glandular denticulate margin, ± elliptic, 5–9 by 2¾–5 cm; nerves 7–9 pairs, meeting in an intramarginal vein; petiole 15–25 mm. *Spike* to 1½ cm; axis glabrous. Bracts and bracteoles persistent, glabrous, ciliate, 3–5 mm. *Calyx* glabrous, divided into three 2½–3 mm long semi-elliptic rounded lobes. *Corolla* 5–6 mm. *Stamens* 40–70. Disk glabrous, but style base hairy. *Ovary* glabrous, 1 mm high; style glabrous. *Fruits* not known.

Distr. Malesia: Philippines (Luzon: Mt Umin-gan, Nueva Ecija), only the type.

Ecol. Montane rain-forest, at least 400 m. *Fl.* Aug.–Sept.

55. *Symplocos verticillifolia* NOOT. Leid. Bot. Ser. 1 (1975) 290. — Fig. 7, 20.

Treelet 7–9 m, 20 cm Ø. Twigs hirsute, glabrescent. *Leaves* in whorls of 4 or 5, sparsely long-pilose beneath, acuminate with cuneate base and glandular denticulate margin, obovate, 6½–11 by 2¼–5 cm; nerves 6–9 pairs, meeting in an intramarginal vein; petiole 8–10 mm. *Flowers* in a reduced axillary fascicle-like spike; axis glabrous, c. 3 mm long. Bracts and bracteoles persistent under the flower, 8–10 and c. 4 mm long respectively. *Calyx* divided into unequal narrowly triangular appressedly long-hairy 2–4 mm long lobes. *Stamens* 70 to more than 100. Disk pilose. *Ovary* glabrous. *Fruit* ellipsoid to cylindrical, immature whitish, 10–12 by c. 5 mm; stone with shallow lengthwise grooves, cylindrical, a little swollen towards both ends, 3-celled but mostly only one cell fertile. *Seed* mostly 1, straight with straight embryo.

Distr. Malesia: Philippines (Samar: Mt Cansayao).

Ecol. Lowland Dipterocarp forest, 200 m. *Fr.* April.

56. *Symplocos vidalii* ROLFE, Kew Bull. (1912) 157; MERR. En. Philip. 3 (1923) 302; NOOT. Leid. Bot. Ser. 1 (1975) 290. — *S. luzoniensis* (non ROLFE) BRAND, Pfl. R. Heft 6 (1901) 61, *pro descr. et specim.* Vidal 2141. — *S. cagayanensis* BRAND, Philip. J. Sc. 7 (1912) Bot. 35; MERR. En. Philip. 3 (1923) 297. — Fig. 7.

Twigs villous to tomentose. *Leaves* patently soft pilose beneath, acuminate with acute to rounded base and recurved, entire to denticulate margin, ± elliptic, 2¾–8 by 1–3 cm; nerves 7–10 pairs; petiole 5–7 mm. *Flowers* in a lax raceme to 5 cm; axis villous. Bracts and bracteoles linear, villous, at least the latter persistent under the fruit, 2–3 and 1½–2½ mm long respectively. Pedicel 1–2 mm. *Calyx* (appressedly) pilose, wholly divided into the

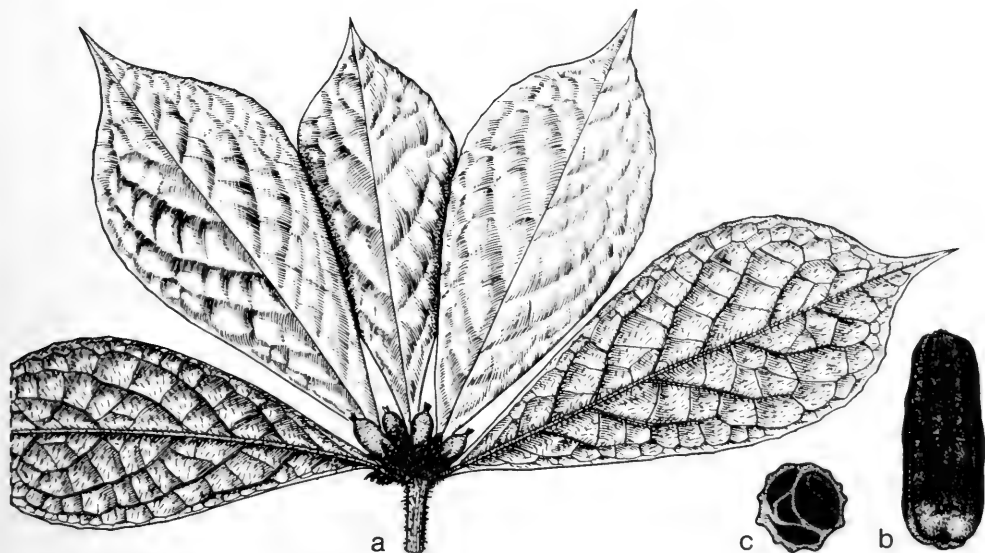


Fig. 20. *Symplocos verticillifolia* NOOT. a. Habit, in fruit, $\times \frac{2}{3}$, b. endocarp, c. ditto in CS, both $\times 3$ (SULIT 14397).

narrowly triangular acute $1-1\frac{1}{2}$ mm long lobes. Corolla $2\frac{1}{2}-3$ mm. Stamens 17-30. Disk glabrous. Ovary with same indument as calyx, $1-1\frac{1}{2}$ mm high. Fruit cylindrical, c. 10 by 3 mm; stone shallowly lengthwise ribbed, 1-celled. Seed 1, straight with straight embryo.

Distr. *Malesia*: Philippines (Luzon: Rizal and Nueva Ecija Prov.).

Ecol. Rain-forest at low and medium altitude. Fl. Febr., fr. April.

57. *Symplocos whitfordii* BRAND, Philip. J. Sc. 3 (1908) Bot. 8; MERR. En. Philip. 3 (1923) 302; NOOT. Leid. Bot. Ser. 1 (1975) 292. — Fig. 7.

Small tree, 6-10 m, 30 cm \varnothing , sometimes fastigate. Twigs glabrous. Leaves glabrous, acuminate with acute, attenuate base and crenate margin, \pm elliptic, $2-5\frac{3}{4}$ by $1-2\frac{1}{2}$ (-3) cm; nerves 5-9 pairs; petiole 2-9 mm. Raceme basally branched; axis glabrous or sparsely (long-)pilose $1\frac{1}{2}-3\frac{1}{2}$ cm. Bracts and bracteoles persistent, glabrous or sparsely pilose on the midrib, 3-8 and $1\frac{1}{2}-3$ mm long respectively. Pedicel $(0-)\frac{1}{2}-2\frac{1}{2}$ mm long. Calyx glabrous, $1\frac{1}{2}-2\frac{1}{2}$ mm long, the lobes ovate, acute, $1\frac{1}{2}-2$ mm. Corolla 5-7 mm. Stamens stout, 20-30. Disk glabrous. Ovary glabrous, $1\frac{1}{2}-3$ mm high; style glabrous. Fruit ovoid, 5-7 by 3-5 mm; stone ampulliform, the belly irregularly grooved. Seed 1, U-shaped, embryo U-shaped.

Distr. *Malesia*: Philippines (Luzon: Mt Pulog; Negros).

Ecol. Montane rain-forest, also in mossy forest, 1600-2450 m. Fl. Jan.-April, fr. Febr., May. Flowers recorded as scentless, the white corolla outside and apically blue violet tinged.

58. *Symplocos zizyphoides* STAPP, Trans. Linn. Soc. Bot. 4 (1894) 205; BRAND, Pfl. R. Heft 6 (1901) 65; MERR. En. Born. (1921) 488; NOOT. Leid. Bot. Ser. 1 (1975) 293. — *S. clementis* MERR. J. Str. Br. R. As. Soc. n. 76 (1917) 111; En. Born. (1921) 486. — Fig. 7.

Small shrub, $\frac{1}{2}$ m, to treelet to 4(-10) m high. Twigs appressedly brown-pubescent, often distinctly zigzag. Leaves alternate, olive-yellow beneath and dark brown to green above when dry, glabrous above, nearly glabrous to appressedly fine-pilose beneath, faintly acuminate with rounded to cuneate base and sharply glandular dentate margin, ovate to elliptic, $2\frac{1}{2}-5\frac{1}{2}$ by $1-2\frac{1}{2}$ cm; nerves 5-8 pairs; petiole 1-2 mm. Flowers solitary and pedicels to 12 mm, or flowers up to 3 or 4 together in a raceme and then with very short pedicel, except sometimes the uppermost flower; axis, pedicels, the c. 4 mm long bracts and the 2-3 mm long bracteoles appressedly brown-pubescent. Calyx less hairy than ovary, c. 2 mm long, the lobes $1-1\frac{1}{2}$ mm. Corolla 4-6 mm. Stamens 40 to more than 100. Disk glabrous or with some minute hairs. Ovary appressedly pubescent, $1-1\frac{1}{2}$ mm high; style glabrous or with some hairs, gradually thickened towards its base, 4-5 mm. Fruit purple to blackish when ripe, ellipsoid to ovoid, sometimes a little curved, 10-12 by 5-6 mm. Seed 1, straight with straight embryo.

Distr. *Malesia*: Borneo (Sabah: Mt Kinabalu). Ecol. Subalpine shrub forest and open places, between granite rocks and on ridges, 2400-3700 m. Fl. Jan.-May, Oct., fr. Jan., March, July.

Dubious

Symplocos aprilis BRAND, Bot. Jahrb. 54 (1916) 221. — Type: LEDERMANN 7559 (B†), New Guinea, Kaiser Wilhelmsland.

Symplocos argenna BRAND, Bot. Jahrb. 54 (1916) 223. — Type: LEDERMANN 11173, 11376 (B†), East New Guinea, Hunsteinspitze.

Symplocos imperialis BRAND, Philip. J. Sc. 4 (1909) Bot. 109; MERR. En Philip. 2 (1923) 299. — Type: BS 4133 FÉNIX, Philippines, Babuyanes Is.

Symplocos ledermannii BRAND, Bot. Jahrb. 54 (1916) 218. — Syntypes: LEDERMANN 11901, 11925, 11977, 11980, 12107, 12118 (B†), East New Guinea, Station Schraderberg.

Symplocos leucocarpa BRAND, Bot. Jahrb. 54 (1916) 221. — Syntypes: LEDERMANN 11031, 12430, 12683 (B†), East New Guinea, Hunsteinspitze.

Symplocos lilacina BRAND, Bot. Jahrb. 54 (1916) 223. — Type: LEDERMANN 11771 (B†), East New Guinea, Schraderberg.

Symplocos oranjeensis BRAND in Fedde, Rep. 26 (1929) 172. — Type: VERSTEEG 2481, New Guinea, Oranje Mts.

Excluded

Symplocos atrocyanea ELMER (Philippines, ELMER 14679), *nom. in sched.* = *Mastixia pentandra* BL. *ssp. philippinensis* (WANG.) MATTHEW (*Cornaceae*).

Incompletely known taxa

A number of Malesian specimens which are represented by incomplete material, but possibly represent new taxa, are listed by NOOTEBOOM in Leid. Bot. Ser. 1 (1975) 296.

LENTIBULARIACEAE (P. Taylor, Kew)

A small family of annual or perennial herbs, all of which are variously adapted for the capture and digestion of small animals (insects, *Crustacea*, etc.). Only one genus (*Utricularia*) occurs in Malesia.

The family is cosmopolitan, including arctic regions, but is more or less absent from Polynesia. It includes 4 genera with c. 250 *spp.*

The largest and most widely spread is the cosmopolitan genus *Utricularia* L. with c. 180 *spp.*, almost half of which occur in the New World, the rest being more or less equally distributed between tropical Africa, Asia, and Australia, with a few in the north temperate zone, 22 *spp.* occurring in Malesia.

Pinguicula L., with some 50 *spp.*, has a curious distribution, with a few circum-boreal species and concentrations in the Mediterranean region and in North, but especially in Central and in South America, as far south as Patagonia.

Genlisea ST.HIL., with c. 16 *spp.*, is confined to the tropics of South America and Africa.

Polypompholyx LEHM., with 2 *spp.*, occurs only in Australia.

All genera are associated with damp or wet habitats and most frequently found on sterile mineral soils where they are often associated with other carnivorous plants (as e.g. *Drosera*).

Unfortunately no fossils are known with certainty, apart from some Quaternary pollen.

The affinities of the family have been the subject of considerable discussion and opinions are divided between a relationship with *Scrophulariaceae* and *Primulaceae*. The combination of free basal (or free central) placentation, a spurred personate corolla (the spur is always present but occasionally reduced), two stamens and the carnivorous habit is diagnostic for the family. In favour of affinity with *Scrophulariaceae* are the morphology of the corolla, the structure and number of the stamens, the bilobed stigma, and such cytological evidence as is available. The pollen of *Lentibulariaceae* is similar to that of both of the families in question. The placentation (and no doubt the mode of dehiscence of the probably most derived aquatic European species, i.e. those most usually studied) is certainly the reason for a suggested alliance with *Primulaceae* but the two families have little else in common. The transition from axile to free central (or basal) placentation by the loss of the septum is quite feasible and the mode of dehiscence of at least what are presumably the most primitive *Utricularia* species could support such a hypothesis.

Within the family the combination of two-lobed calyx and trap structure is diagnostic for the genus *Utricularia*. *Polypompholyx* is very close to *Utricularia* but with 4 calyx lobes in two whorls. *Genlisea* and *Pinguicula* both have true leaves and a 5-lobed calyx, the traps of the former genus being extremely complex but quite different from those of *Utricularia*. *Genlisea* has also a unique type of fruit dehiscence — likening the fruit to a globe it splits at the equator and at least partially at both tropics. *Pinguicula* has an apparently much less complex trapping mechanism consisting of two types of superficial glands on the leaves while the dehiscence is constantly valvate. Theories have been advanced as to how the various trapping mechanisms could be derived one from the other but they are on the whole unconvincing.

UTRICULARIA

LINNÉ, Gen. Pl. ed. 5 (1754) 11; Sp. Pl. (1753) 18; A. DC. in DC. Prod. 8 (1844) 3; B. & H. Gen. Pl. 2 (1876) 987; KAMIENSKI in E. & P. Nat. Pfl. Fam. 4, 3b (1895) 119; P. TAYLOR, Kew Bull. 18 (1964) 1; Mem. N.Y. Bot. Gard. 17, 1 (1967) 206; KOMIYA, J. Jap. Bot. 48, 5 (1973) 149. — *Polypompholyx* (non LEHM.) BENJ. in Mart. Fl. Bras. 10 (1847) 251; Linnaea 2 (1847) 447; GRISEB. Cat. Pl. Cub. (1866) 162; PELLEGR. Bull. Soc. Bot. Fr. 60 (1914) 514; *ibid.* 61 (1914) 20; PERRIER, Mém. Inst. Sci. Madag. sér. B. 5 (1955) 199; in Humbert, Fl. Madag., Lentib. (1955) 19. — *Biovularia* KAMIENSKI, Zap. Novoross. Obtsch. Est. 12 (1890) 204; in E. & P. Nat. Pfl. Fam. 4, 3b (1895) 122; Bot. Jahrb. 33 (1902) 113; BARNH. Mem. N.Y. Bot. Gard. 6 (1915) 58; MELCHIOR in Engl. Syll. Pfl. ed. 12, 2 (1964) 467. — **Fig. 1-26.**

Annual or perennial aquatic terrestrial or epiphytic herbs always of damp places, without true roots or leaves but with stems modified in various ways to function as rhizoids, stolons and foliar organs, all species bearing small complex bladder-like traps for the capture and digestion of small aquatic organisms. *Inflorescence* racemose, peduncled, usually simple, bracteate; sterile bracts (scales) often present on the peduncle and sometimes also on the inflorescence axis; two bracteoles often present, almost always at the base of the pedicel, usually free, rarely \pm connate with the bract. Bracts very varied, basifixed, medifixed or variously produced below the point of attachment. *Calyx* 2-lobed, usually \pm accrescent, the lobes \pm equal or variously dissimilar, usually free, sometimes \pm connate at the base. *Corolla* bilabiate, yellow, various shades of violet or purple, white or rarely blue or red; upper lip entire or 2- or more-lobed; lower lip with an entire or 2-5-lobed limb, a \pm raised, often gibbous palate and a usually subulate or conical spur, in a few species reduced to a short sac. *Stamens* 2 inserted at the base of the upper lip; filaments usually short, linear, often curved and often \pm flattened and dilated above; anthers dorsifixed, \pm ellipsoid, thecae \pm confluent. *Ovary* globose or ovoid, ovules 2-many on a free basal or free central \pm fleshy placenta; style usually short; stigma bilabiate, the lower lip usually much larger. *Capsule* globose or ovoid, dehiscing very variously by longitudinal slits, dorsiventral or rarely lateral valves, pores or circumscissile or rarely indehiscent. *Seeds* 1-many, very variously shaped and sculptured.

Distr. Cosmopolitan but mostly in the tropical zone. About 180 *spp.*, almost half of which occur in the New World, the rest more or less equally distributed between tropical Africa, Asia and Australia with a few in the north temperate zone; in *Malesia* 22 *spp.*

The geographical relationships of the Malesian *spp.* are of some interest. Twelve species are more or less widespread throughout tropical Asia and Australia and four of these occur also in tropical Africa. *U. subulata* is widespread in tropical America and Africa, apparently absent from India, but present in Thailand, Malaya and Borneo. *U. pulchra*, which is allied to the very widespread *U. striatula*, appears to be endemic in New Guinea while *U. salwinensis* of the same affinity is known only from the Gajo mountains of North Sumatra and from SW. China (Yunnan). *U. vitellina* is apparently local-endemic in Malaya while the allied *U. involvens* is known from that country, adjacent Burma, Thailand, and N. Australia. *U. heterosepala*, a slightly anomalous species in the same group (which is predominantly Asian but with representatives in tropical Africa and to a lesser extent in America) appears to be endemic in the Philippines. The circumboreal species *U. minor* occurs at high altitudes in New Guinea and *U. australis*, which is widely distributed in the Old World north temperate zone, occurs, mostly at high altitudes, in a number of places in Malesia; it is known also in the mountains of tropical Africa and at lower altitudes in SE. Australia. Two species known otherwise only from northern Australia occur in SE. New Guinea: *U. chrysanthia* and *U. muelleri*. One strange apparent absence from the Malesian region is *U. stellaris* which is known from tropical Africa and Asia as far as Indo-China and reappears in northern Australia. It is included in the key to the species as it seems very probable that it does occur in the area.

Ecol. Marshes, wet grassfields, swamps, swamp-forest, streams and rivers and open damp sandy ground, a few species epiphytic among moss on trees (and rocks), occurring in Malesia from sea-level to 3660 m.

Pollination. The flowers often secrete nectar and in some species are fragrant. Pollination by *Diptera* and *Hymenoptera* has been observed and the flowers are sometimes visited by *Lepidoptera*. However, self pollination is probably usual and cleistogamous forms are frequent and in some species inflorescences normally bear both cleistogamous and chasmogamous flowers.

Dispersal. Dispersal over short distances can easily take place in aquatic species by floating of entire plants or parts thereof, or by dispersal of buds (turions), according to RIDLEY (Disp. 1930).

Seeds are mostly very small and sometimes winged and therefore perhaps sometimes dispersed by wind, although gravity is probably the most normal agent. In some of the aquatic species the seeds do not float, or they do so only for a time (RIDLEY, Disp. 1930, 220). A few (not *Mal. spp.*) growing in swiftly flowing water have seeds with a mucilaginous testa and in the epiphytic species the seeds are either very small (orchid-like) or winged or (*U. striatula*) beset with glochidiate processes. Fig. 13t.

The occurrence of some species which are epiphytic among moss on tree-trunks in dense primary rain-forest where there is hardly any wind might point to very short-distance dispersal by ants or other insects. Fig. 14.

In open terrain the seed qualities would point to wider exozooic dispersal by migrating waterfowl and waders for aquatic species, and by wind. This might induce dispersal enthusiasts to explain the enormous disjunct gaps in the range of *U. minor* between Burma and New Guinea, and that of *U. stellaris* between Indo-China and Australia by erratic long-distance dispersal.

However, several terrestrial species show similar wide disjunctions, e.g. *U. salwinensis* between Yunnan and North Sumatra, *U. scandens* and *U. limosa* between the Malay Peninsula and New Guinea, and *U. baouleanensis* between Luzon and Java. Though the present revision is based upon some 2000 collections, the latter two species may have escaped attention of collectors in intermediate stations. However, the disjunct range of the subalpine *U. salwinensis* is certainly a real gap, as high mountains are at present absent between Yunnan and N. Sumatra. A similar disjunction is found in the ranges of other high mountain plants, such as for example *Swertia bimaculata* and *Viola biflora* which are certainly not overlooked.

It should be admitted, though, that *Utricularia* must often have escaped attention of collectors, especially in seasonal areas where flowering is of short duration and ephemeral. On the other hand in a thoroughly explored island as Java, *U. baouleanensis* is known only from Madura I. in one collection. This leads to the conclusion that it is most unlikely that the gaps mentioned above will be reasonably filled by later exploration, especially these of the high altitude species. This argument is strengthened by the fact that these disjunctions are by no means unique: the gap of *U. salwinensis* is matched by that of *Viola biflora*, *Hedyotis verticillaris*, etc., the gap of *U. minor* by that of *Drosera rotundifolia* and several *Carices*, but also by that found in *Fagoideae*. Even an extraordinary range as that of *U. livida*, which is found in East Africa and Madagascar but also in Mexico, is \pm matched by a few other taxa or affinities with similar disjunction, in tropical America, e.g. tribe *Ravenaleae* (*Musaceae*) and *Rheedia* (*Guttiferae*).

Then there are some Indo-Australian species showing a huge disjunction: *U. involvens*, Burma, Thailand, Malaya and N. Australia, and a closely related one, *U. odorata*, Thailand, Indo-China and N. Australia.

It gives thought to the assumption that these disjunctions cannot simply be explained by erratic long-distance dispersal. Also the occurrence of three local-endemic species makes such a correlation with dispersal capacity highly dubious and does not plead for easy dispersal. Neither does the fact that the ecology of many *Utricularia* spp. is very wide; they are not particular to soil, many are found in the tropics under both everwet and seasonal climatic conditions, and a fair number have a very large altitudinal range.

On the other hand it must be realized that the very widely distributed *U. australis*, which ranges all over the Old World with isolated sporadic localities on the southern hemisphere, is not known to produce fruit and seed, which forces to assume dispersal of small particles of its vegetative parts by migrating birds. This implies that such parts should be capable to withstand desiccation which will certainly happen during such migratory flight. Experiments could add some evidence. It is e.g. shown by V. A. WAGER (Trans. R. Soc. S. Afr. 16, 1928, 204, pl. 24) that *U. australis* (under the erroneous name *U. stellaris*) forms resting buds towards the end of the season which may carry the plant over until the following spring. These resting buds are not damaged by exposure to drought; buds taken from a herbarium specimen six months old put into an aquarium slowly swelled and developed into healthy plants.

Chromosomes. Relatively few (about 15%) of the species of *Utricularia* have been examined; the chromosomes are apparently small and not easily observed. Basic numbers of $x = 7$ and 9 seem to predominate but $x = 6, 8, 10, 11$ and 15 are recorded. An American species, *U. inflata* WALT., has $2n = 18$ and 36, the latter being morphologically gigantic whereas the closely allied *U. radiata* SMALL has $2n = 28$. The common Australian species *U. dichotoma* LABILL. has $2n = 28$ while conversely a morphologically small variant of this, *U. uniflora* R.Br., has $2n = 56$. Cf. J. CASPAR in Fedde, Rep. 86 (1975) 211-232.

Morph. The most remarkable feature of the genus are the traps. They are minute vesicles provided with an apical orifice at the ventral side. The narrow opening leading to the water-filled cavity is formed by a ventral lip, and a dorsal valve which enables the prey to enter, but prevents it from escaping, in which it is also hampered by glandular papillae of striking structure. The inner wall of the trap is densely glandular-papillose and exudes proteolytic enzymes.

The functioning of the trap, by the opening of the valve, is caused by irritation of the sensitive hairs on this lid by which small crustacea or other matter is 'sucked' in. See E. MERL (Flora: Allg. Bot. Z. 115,

1922, 59–74) extracted by JACOBSON in Trop. Natuur 17 (1928) 107–113, 4 fig., in Dutch, and especially F. E. LLOYD, The Carnivorous Plants (1942) 233–270; furthermore the excellent survey by Y. HESLOP-HARRISON (Endeavour 35, 1975, 114–122).

Palyn. Pollen grains are tricolporate or stephanocolporate with up to 28 colpi. Tetrads occur in two species of *Utricularia*. Size ranges from 17 μ m in *U. neottiioides* to 51 μ m in *U. humboldtii*. Shape varies from oblate to prolate. Sculpture is generally smooth in *Utricularia* or finely reticulate as in *Pinguicula* (ERDTMAN, Pollen morphology and plant taxonomy. Angiosperms. Almquist & Wiksell, Stockholm, 1952, 233–234).

In *Utricularia* HUYNH (Étude de la morphologie du pollen du genre *Utricularia* L., Pollen et Spores 10, 1968, 11–55) has described a considerable amount of pollen-morphological variability. Tricolporate types with long or very short colpi and stephanocolporate types with equatorially fused endoapertures occur. In some types the apocolpia are dissected by interconnections between colpi.

A remarkable similarity exists between the stephanocolporate grains in *Utricularia* and the pollen of *Polygalaceae*. — J. MULLER.

Notes. The study of *Utricularia* has always been hampered by badly collected and inadequate material. Of the aquatic species the vegetative parts should be suitably supported by a (rigid) sheet of paper and thus be raised out of the water in their natural position and then dried as rapidly as possible. Additional inflorescences and infructescences should be added. Terrestrial species have often not very obvious vegetative parts which are usually beneath or in the substrate. They must be carefully 'unearthed', or dried with the adhering mud.

Specimens in liquid are of course excellent. FAA is not so suitable; the best solution is a mixture of 50–55% alcohol, 40% water and 5–10% glycerine; the latter may be omitted or even added later; it is important that the receptacle is entirely filled with liquid.

It is important to take many flowers but see that also fruit and seed are represented.

As two or more terrestrial species are frequently growing together, with their vegetative parts intimately mixed in the substrate, care is needed in collecting. It is important to note the flower colour; this is in several species very variable.

Hardly any *Utricularia* spp. have been collected in the Lesser Sunda Islands. Though this archipelago is subject to a dry season, collecting at the end of the wet season in rice-fields, shallow swamps and damp grassland may yield interesting results, as several species have been found in the adjacent Madura & Kangean Islands which have the same climatic regime.

KEY TO THE SPECIES

1. Foliar organs conspicuous and numerous at anthesis, divided into narrowly linear to capillary segments, the ultimate segments bearing apical and often lateral solitary or fasciculate setulae.
2. Turions (winter buds) of tightly clustered modified foliar segments present at the apex of some of the stolons.
3. Turions glabrous or almost so. Ultimate foliar segments with minute apical but with or without microscopic lateral setulae 22. *U. minor*
3. Turions densely setulose. Ultimate foliar segments with \pm numerous lateral setulae. 21. *U. australis*
2. Turions not present.
4. Primary foliar segments 3 or more semi-verticillate on the stolons usually with hyaline or foliose setulose stipule-like segments at the base. Scales on peduncle absent.
5. Peduncle with a whorl of inflated ellipsoid floats some distance above the base. Basal segments of foliar organs hyaline.
6. Floats shortly stipitate with capillary foliar segments at the base. Capsule much longer than the calyx lobes. Seeds thinly lenticular with a single marginal wing 20. *U. muelleri*
6. Floats sessile without foliar segments at the base. Capsule shorter than the calyx. Seeds prismatic, narrowly winged on the angles. Africa, Madagascar, SE. Asia, Australia. Cf. P. TAYLOR, Kew Bull. 18 (1964) 189, f. 77 6–11, 79; ASTON, Aquat. Pl. Austr. (1973) f. 39 a–j *U. stellaris* L. f.
5. Peduncle without floats or with a whorl of narrowly fusiform floats at the base. Basal segments of foliar organs foliose 19. *U. aurea*
4. Primary foliar segments 1 or 2 usually without stipule-like segments at the base. Scales (or at least one) present on the peduncle.
7. Foliar organs less than 10 mm long with few (2–10) ultimate segments with few or no lateral setulae.
8. Ultimate segments distinctly flattened with microscopic or no lateral setulae. Bracts and scales auriculate, the scales few but dispersed through the length of the peduncle. Spur of the corolla very short, saccate. Capsule circumscissile. Seeds prismatic 22. *U. minor*
8. Ultimate segments terete, sometimes with a few lateral setulae. Bracts and scales not auriculate, scales usually only one near the middle of the peduncle. Spur of the corolla narrowly conical. Capsule laterally bivalvate. Seeds lenticular, winged 18. *U. exoleta*
7. Foliar organs more than 20 mm long with very numerous ultimate segments bearing \pm numerous lateral setulae.
9. Ultimate segments terete. Traps absent from the lowermost part of the foliar organs. Bracts and scales medifixed, the scales disposed through the length of the peduncle. Corolla mauve or white. Seeds with a broad dentate wing 17. *U. punctata*

9. Ultimate segments distinctly flattened. Traps present in the lowermost part of the foliar organs and with rudimentary traps at the very base. Bracts and scales basifixed, slightly auriculate, the scales few and usually present only in the upper part of the peduncle. Corolla yellow.
21. *U. australis*
10. Bracts medifixed or produced below the point of attachment.
11. Bracteoles present.
12. Calyx lobes approximately equal in size. Foliar organs linear to narrowly obovate, usually not conspicuous at anthesis
11. *U. caerulea*
12. Calyx lobes very unequal in size, the upper much larger. Foliar organs reniform to obovate, usually present and \pm conspicuous at anthesis.
13. Corolla lower lip 3-lobed, the lateral lobes obliquely emarginate, spur c. 2 mm long. Seeds ovoid, densely echinate
14. *U. salwinensis*
13. Corolla lower lip \pm regularly 5-lobed, spur at least 5 mm long.
14. Spur over 10 mm long, usually longer than and widely diverging from the lower lip of the corolla. Flowers 1 or 2. Peduncle up to 6 cm long, relatively stout
13. *U. pulchra*
14. Spur c. 5 mm long, usually about as long as and \pm parallel with the lower lip of the corolla. Flowers up to 10. Peduncle up to 15 cm long, very slender. Seeds pyriform, glchidiate.
12. *U. striatula*
11. Bracteoles absent.
15. Lower lip of corolla deeply 2-lobed, corolla pink or white. Pedicel minutely papillose. Seeds globose with distinct coarse isodiametric reticulation
15. *U. limosa*
15. Lower lip of corolla deeply 3-lobed, corolla yellow. Pedicel smooth. Seeds ellipsoid with indistinct coarse very elongate reticulation
16. *U. subulata*
10. Bracts basifixed.
16. Bracteoles absent. Lower calyx lobe much longer than upper in fruit
6. *U. heterosepala*
16. Bracteoles present. Calyx lobes \pm equal or upper longer.
17. Bracteoles not much narrower (at least half as wide) than the bract.
18. Calyx, peduncle and pedicels \pm densely covered with often long septate hairs
10. *U. hirta*
18. Calyx glabrous. Peduncle glabrous or with a few short septate hairs
9. *U. minutissima*
17. Bracteoles much narrower (less than one quarter as wide) than the bract.
19. Lower lip of corolla deeply 4-lobed. Corolla yellow
8. *U. carysantha*
19. Lower lip of corolla entire, emarginate or \pm 3-lobed.
20. Corolla yellow.
21. Peduncle twining.
22. Corolla (11-)15-20 mm long, upper lip orbicular, much wider than the calyx lobes.
2. *U. involvens*
22. Corolla 5-10 mm long, upper lip oblong, narrower than the calyx lobes
5. *U. scandens*
21. Peduncle erect.
23. Lower lip of corolla 3-lobed, corolla 15-22 mm long
1. *U. vitellina*
23. Lower lip of corolla entire or emarginate, corolla 6-10 mm. Pedicels strongly recurved in fruit
3. *U. bifida*
20. Corolla mauve or white.
24. Peduncle twining. Pedicels strongly reflexed in fruit.
7. *U. baouleensis*
24. Peduncle erect. Pedicels erect or spreading in fruit.
4. *U. uliginosa*

1. *Utricularia vitellina* RIDL. Fl. Mal. Pen. 2 (1923) 492; SPARE, Mal. Nat. J. 1 (1940) 89. — *U. aurea* (non LOUR.) RIDL. J. Fed. Mal. St. Mus. 6 (1915) 165. — Fig. 1.

Terrestrial. *Rhizoids* capillary, simple. *Stolons* capillary, sparsely branched. *Foliar organs* present at anthesis, sparsely rosulate, narrowly linear, membranous, 1-2 cm long, 0.5-1 mm wide, 1-nerved, apex rounded. *Traps* few on the stolons and foliar organs, globose, 0.5-1 mm long, shortly stalked, mouth basal, upper lip with 2 short subulate reflexed appendages. *Inflorescence* erect, 2.5-5 cm long; peduncle filiform, terete, glabrous; flowers 1-2; scales few in the lower third of the peduncle, the lowermost usually at its very base, similar to the bracts; bracts basifixed, ovate-deltoid, acute, c. 1.5 mm long; bracteoles narrowly linear, acute, slightly shorter than the bract; pedicels spreading, usually curved, 4-8 mm long, dorsiventrally flattened, very narrowly winged. *Calyx lobes* unequal, upper narrowly ovate, c. 4.5 mm long, apex obtuse, lower similar but c. 3 mm long,

apex obscurely bidentate. *Corolla* yellow streaked with brown, 15-22 mm long, upper lip obovate-oblong to \pm orbicular, slightly longer than the upper calyx lobe, apex rounded or emarginate, lower lip much larger, up to 10 mm wide, \pm orbicular, apex distinctly 3-lobed, palate scarcely prominent, spur subulate, about as long as the lower lip but widely diverging from it, usually strongly curved. *Filaments* filiform, \pm straight, c. 1 mm long, anther thecae distinct. *Ovary* ovoid, style short, distinct, stigma lower lip orbicular, upper obsolete. *Capsule* and *seeds* not known.

Distr. *Malesia*: Malay Peninsula (Pahang: G. Tahan and G. Kerbau only).

Ecol. Peaty streambanks in moss, c. 1500-2100 m. Fl. Jan.-July.

2. *Utricularia involvens* RIDL. J. Bot. 33 (1895) 11; PRAIN, J. As. Soc. Beng. 74, ii (1905) 371; RIDL. Fl. Mal. Pen. 2 (1923) 493, f. 121; SPARE, Mal. Nat. J. 1 (1940) 89. — Fig. 3.

Terrestrial. *Rhizoids* few, capillary, basally

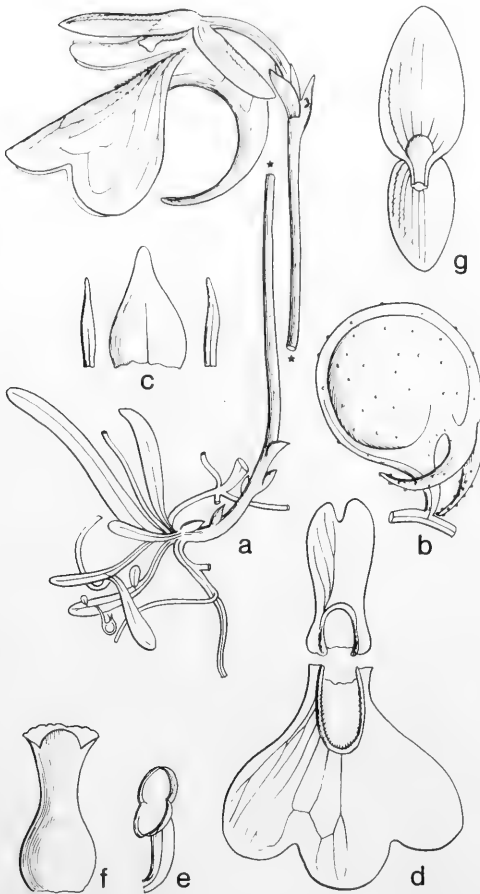


Fig. 1. *Utricularia vitellina* RIDL. a. Flowering plant, $\times 4$, b. trap, $\times 24$, c. bract & bracteoles, $\times 12$, d. corolla, the two lips from inside, $\times 4$, e. stamen, $\times 12$, f. pistil, $\times 12$, g. calyx, $\times 6$ (all after RIDLEY, type, except b SPARE S4/41).

thickened, with numerous papillose branches 0.5–1 mm long. *Stolons* few, capillary, branched. *Foliar organs* usually conspicuous at anthesis, rosulate and on the stolons, obovate to narrowly oblong, membranous, up to 2.5 cm long, 2–4 mm wide, multinerved, apex rounded. *Traps* on the vegetative organs, globose, 0.5–1 mm long, shortly stalked, mouth basal, upper lip with 2 simple subulate appendages, lower lip with 1 short obtuse appendage. *Inflorescence* twining, up to 30 cm long; peduncle filiform, terete, glabrous; flowers 2–6, distant; scales numerous, similar to the bracts; bracts basifixed, ovate, acute, 2–3 mm long; bracteoles subulate, shorter than the bract; pedicels erect or spreading, filiform, 10–15 mm long, narrowly winged. *Calyx lobes* subequal, ovate to

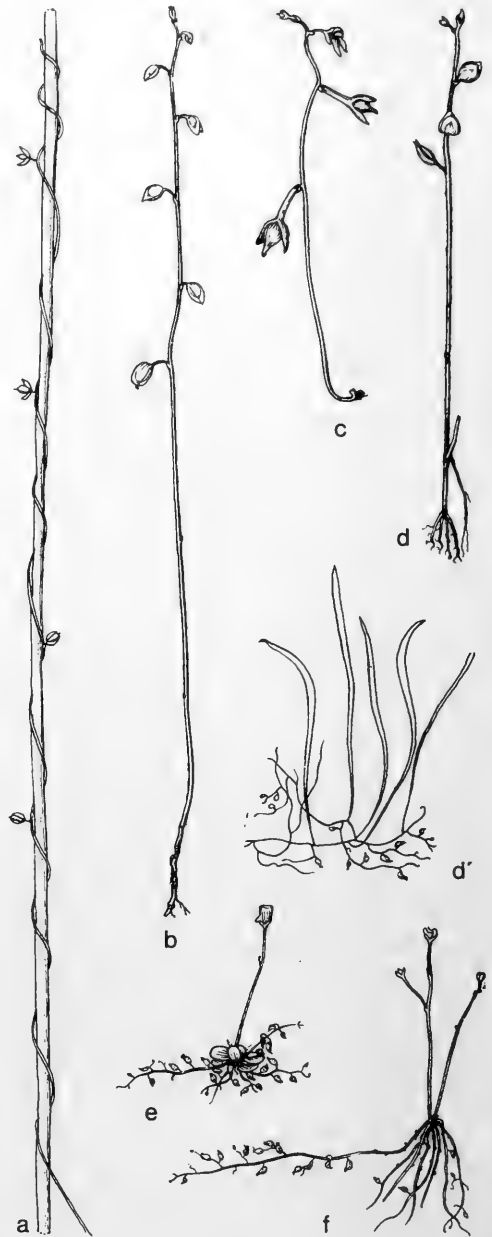


Fig. 2. Habit of some *Utricularia* species. a. *U. baouleensis* A.CHEV. trailing along a sedge, b. *U. bifida* L., c. *U. aurea* LOUR. (inflorescence only), d. *U. uliginosa* VAHL and d'. detail of vegetative parts, e. *U. striatula* J.SM. with cleistogamous flowers, f. *U. exoleta* R.BR. All $\times 2/3$.

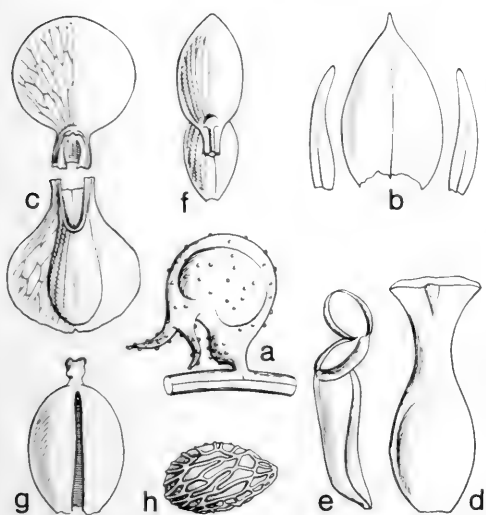


Fig. 3. *Utricularia involvens* RIDL. a. Trap, $\times 24$, b. bract & bracteoles, $\times 12$, c. corolla, the two lips from inside, $\times 2$, d. pistil, $\times 12$, e. stamen, $\times 12$, f. fruiting calyx, $\times 2$, g. dehiscent capsule, $\times 4$, h. seed, $\times 24$ (a, b, h DING HOU 783, the others after RIDLEY, type).

broadly ovate, 4–5 mm long at anthesis, up to 7 mm long in fruit, upper slightly larger, apex obtuse or subacute, lower shortly bidentate. Corolla yellow, 11–20 mm long, upper lip orbicular, longer than the upper calyx lobe, 7–12 mm wide, apex rounded, lower lip \pm orbicular, up to 15 mm wide, apex emarginate, palate very conspicuously raised, gibbous, extending almost to the apex of lower lip, spur subulate, straight or slightly curved, about as long as but widely diverging from the lower lip. Filaments linear, curved, c. 1.5 mm long, anther thecae subdistinct. Ovary ovoid, style relatively long, stigma lower lip orbicular, deflexed, upper lip obsolete. Capsule broadly ovoid, dorsiventrally compressed, uniformly membranous, 4–5 mm long, dehiscent by dorsal and ventral longitudinal slits. Seeds numerous, ovoid, c. 0.4 mm long, testa conspicuously coarsely reticulate, reticulations elongate.

Distr. S. Burma (Tenasserim), Thailand, N. Australia, and Malesia: Malay Peninsula (Kedah Peak, G. Jerai).

Ecol. Damp grassy places and along creeks, 900–1000 m in Malaya but at low altitude in Thailand and Australia. Fl. April–Jan.

3. *Utricularia bifida* LINNÉ, Sp. Pl. (1753) 18; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 182; CLARKE, Fl. Br. Ind. 4 (1884) 332; RIDL, Trans. Linn. Soc. Lond. II, Bot. 3 (1893) 327; Fl. Mal. Pen. 2 (1923) 492; MERR. En. Philip. 3 (1923) 466; PELLEGR. Fl. Gén. I.-C. 4 (1930) 482; STEEN. Arch. Hydrobiol. Suppl. 11 (1932) 331, f. 8 I;

HAND.-MAZZ. Symb. Sin. 7 (1936) 872; BACK. & BAKH. f. Fl. Java 2 (1965) 518; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 529. — *U. recurva* LOUR. Fl. Coch. (1790) 26. — *U. humilis* VAHL, Enum. 1 (1804) 203. — *U. ramosa* VAHL, l.c. 204. — *U. antirrhinoides* WALL. Cat. (1829) n. 1498, nomen. — *U. wallichiana* BENJ. Bot. Zeit. 3 (1845) 213. — *U. brevicaulis* BENJ. Linnaea 20 (1847) 303. — *U. sumatrana* MIQ. Fl. Ind. Bat. 2 (1859) 998, p.p.; Suppl. 1 (1860) 246. — *U. biflora* HAYATA, J. Coll. Sc. Imp. Un. Tokyo 30 (1911) 210; Ic. Pl. Formos. 2 (1913) 125. — Fig. 2b, 4.

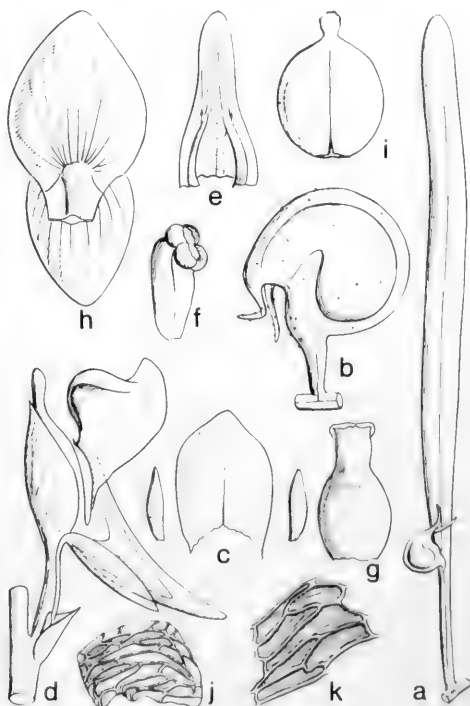


Fig. 4. *Utricularia bifida* L. a. Foliar organ, $\times 6$, b. trap, $\times 24$, c. bract & bracteoles, $\times 15$, d. flower, $\times 6$, e. upper lip of corolla, $\times 6$, f. stamen, $\times 12$, g. pistil, $\times 12$, h. fruiting calyx, $\times 6$, i. capsule, $\times 6$, j. seed, $\times 45$, k. testa, $\times 75$ (all after LARSEN 5121).

Terrestrial. Rhizoids few, capillary, basally thickened, with numerous papillose branches 0.5–1 mm long. Stolons few, capillary, branched. Foliar organs usually \pm conspicuous at anthesis on the stolons, narrowly linear, membranous, 1–2 cm long, up to 1 mm wide, 1-nerved, apex rounded. Traps on the vegetative organs, globose, 0.6–1 mm long, stalked, mouth basal, upper lip with 2 simple subulate appendages, lower lip with a \pm well developed obtuse swelling at the distal end of the stalk. Inflorescence erect, 5–20 cm long; peduncle filiform, terete, glabrous above, minutely glandular

below; flowers 1–10, distant; scales few, similar to the bracts; bracts basifixed, broadly ovate-oblong, obtuse, c. 1 mm long; bracteoles linear-subulate, c. 0.5 mm long; pedicels erect at anthesis strongly recurved in fruit, filiform, distinctly winged, 2–4 mm long. *Calyx lobes* subequal, the upper slightly larger, broadly ovate, base \pm broadly connate and decurrent, apex obtuse, c. 3 mm long at anthesis, up to 6 mm long in fruit. *Corolla* yellow, 6–10 mm long, upper lip narrowly oblong, 1–2 mm wide, apex rounded, slightly longer than upper calyx lobe, lower lip \pm orbicular, up to 4 mm wide, apex rounded, palate conspicuously raised, gibbous, spur subulate, acute, curved, longer than and widely diverging from the lower lip. *Filaments* oblong, straight, c. 1 mm long, c. 0.5 mm wide, anther thecae subdistinct. *Ovary* ovoid, style short but distinct, stigma lower lip quadrate, deflexed, upper lip much shorter, entire or bidenticulate. *Capsule* broadly elliptic, dorsiventrally compressed, uniformly membranous, 2.5–3 mm long, dehiscing by a single ventral longitudinal slit. *Seeds* numerous, \pm ovoid, c. 0.4 mm long, testa rugose, reticulate, reticulations relatively large, elongate.

Distr. India to China and Japan, Indo-China, Malaysia to northern Australia; in *Malaysia* not recorded from the Lesser Sunda Is. (but present in Kangean Is.) or Moluccas, but common elsewhere.

Ecol. Swamps and marshes, sometimes as a weed in rice-fields, on moist sandy plains, floating in lakes, in *Sphagnum* swamps, on edge of *Melaleuca* swamp and in moist Eucalypt savannahs, mainly at low altitude, but up to at least 2000 m (in Java and New Guinea). *Fl.* Jan.–Dec.

Vern. Malaya: *bunga janggut kéli*, *b. këning layah*, M; New Guinea: *ararëbo*, *pëkatorro*, Kapauko lang.

4. *Utricularia uliginosa* VAHL, Enum. 1 (1804) 203; SANTAPAU, J. Bomb. Nat. Hist. Soc. 49 (1950) 217; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 532. — *U. cyanea* R.BR. Prod. Nov. Holl. (1810) 431; GUILLAUMIN, Fl. Nouv.-Caléd. (1948) 319. — *U. affinis* WIGHT, Ic. (1850) t. 1580; MIQ. Fl. Ind. Bat. Suppl. 1 (1860) 246; CLARKE, Fl. Br. Ind. 4 (1884) 330; TRIMEN, Handb. Fl. Ceyl. 3 (1895) 269; PELLEGR. Fl. Gén. I.-C. 4 (1930) 479; STEEN. Arch. Hydrobiol. Suppl. 11 (1932) 333, f. 8 III; BACK. & BAKH. f. Fl. Java 2 (1965) 518. — *U. griffithii* WIGHT, Ic. (1850) t. 1576; MIQ. Fl. Ind. Bat. 2 (1859) 999; RIDL. Fl. Mal. Pen. 2 (1923) 492; SPARE, Mal. Nat. J. 1 (1940) 89. — *U. affinis* var. *griffithii* (WIGHT) OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 179; CLARKE, Fl. Br. Ind. 4 (1884) 331; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 119; PRIN, J. As. Soc. Beng. 74, ii (1905) 370; MERR. En. Born. (1921) 537. — Fig. 2d, 5.

Terrestrial. *Rhizoids* few capillary, basally thickened, with numerous papillose branches c. 1 mm long. *Stolons* few, capillary, branched, up to 6 cm long or more. *Foliar organs* often not conspicuous at anthesis, on the stolons, ovate to linear, membranous, up to 4 cm long, 1.5–6 mm wide, multinerved, apex obtuse to subacute. *Traps* on the stolons and foliar organs, globose, 1–2 mm long, shortly stalked, mouth basal, upper lip with 2 simple subulate appendages. *Inflorescence* erect, up to 30 cm long; peduncle filiform, terete, glab-

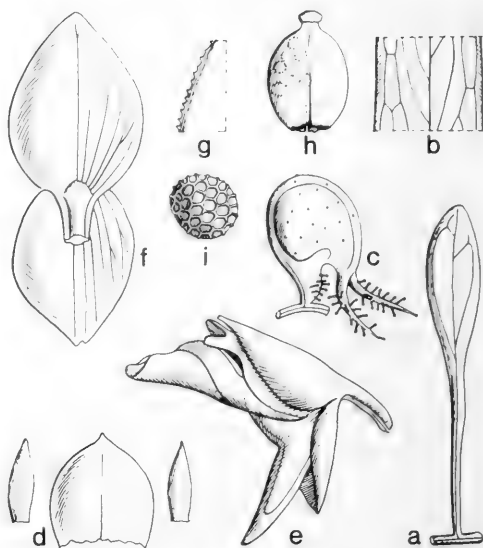


Fig. 5. *Utricularia uliginosa* VAHL. a. Small, young, foliar organ, $\times 6$, b. part of fully developed foliar organ, venation, $\times 4$, c. trap, $\times 12$, d. bract & bracteoles, $\times 12$, e. flower, $\times 6$, f. fruiting calyx, $\times 6$, g. margin of this, $\times 24$, h. capsule, $\times 6$, i. seed, $\times 24$ (all after SINCLAIR 10157).

rous; flowers 2–10, rather distant; scales few, similar to the bracts; bracts basifixed, ovate, acuminate, 2–3 mm long, 3-nerved; bracteoles subulate, about half as long as the bract, 1-nerved; pedicels erect 1.5–2 mm long at anthesis, often spreading and up to 3 mm long in fruit, filiform distinctly winged. *Calyx lobes* subequal, very broadly ovate to almost orbicular, c. 2.5 mm long at anthesis, up to 5 mm long in fruit, surface minutely papillose, margin usually minutely denticulate, upper lobe slightly larger, apex very shortly acuminate, lower with apex shortly bifid. *Corolla* blue, violet, mauve or white, 3–7 mm long, upper lip \pm orbicular scarcely longer than upper calyx lobe, apex rounded, emarginate or \pm bifid, lower lip larger, \pm orbicular, apex rounded, entire or \pm obscurely 3-crenate, palate raised, gibbous, spur conical-subulate, acute, curved or \pm straight, longer than and widely diverging from the lower lip. *Filaments* linear, curved, c. 1.5 mm long, anther thecae distinct. *Ovary* ovoid, style short but distinct, stigma lower lip quadrate, upper lip obsolete. *Capsule* broadly ellipsoid, dorsiventrally compressed, 2–4 mm long uniformly membranous, dehiscing by dorsal and ventral longitudinal slits. *Seeds* numerous, \pm globose or very broadly ellipsoid, c. 0.3–0.4 mm long, testa thin, conspicuously reticulate, reticulations \pm regularly hexagonal isodiametric or very slightly elongate, hilum not prominent.

Distr. India to Japan and Australia, also in New Caledonia; in *Malaysia*: Sumatra (also Banka & Riouw Is.), Malaya, Java, Borneo, and New Guinea.

Ecol. Swamps, streamsides and wet sandy places, abandoned mining-land, in *Melaleuca* savannahs, in siil grass-wastes, both under ever-wet and seasonal climatic conditions, from sea-level to 2100 m (in New Guinea). *Fl.* Jan.-Dec.

5. *Utricularia scandens* BENJ. *Linnaea* 20 (1847) 309; P. TAYLOR, *Dansk Bot. Ark.* 23 (1968) 531. — *U. volubilis* WIGHT *ex* BENJ. *Linnaea* 20 (1847) 309, *non* R. BR. 1810, *pro syn.* — *U. wallichii* WIGHT, Hook. *J. Bot. Kew Misc.* 1 (1849) 372. — *U. wallichiana* WIGHT, *lc.* 4 (1850) t. 1572, *non* BENJ. 1845; OLIVER, *J. Linn. Soc. Lond. Bot.* 3 (1859) 182; CLARKE, *Fl. Br. Ind.* 4 (1884) 332; PRAIN, *J. As. Soc. Beng.* 74, ii (1905) 371; RIDL, *Fl. Mal. Pen.* 2 (1923) 493; GAMBLE, *Fl. Madras* 2 (1924) 982; PELLEGR. *Fl. Gén. I.-C.* 4 (1930) 484; SPARE,

Mal. Nat. J. 1 (1940) 89. — *U. gibbsiae* STAPP, *Fl. Trop. Afr.* 4 (1906) 574. — *Polypompholyx madecassa* PERRIER, *Mém. Inst. Sci. Madag. sér. B.* 5 (1955) 199; in Humbert, *Fl. Madag.*, *Lentib.* (1955) 19. — *U. scandens ssp. scandens* P. TAYLOR in Hutch. & Dalz. *Fl. W. Trop. Afr.* ed. 2, 2 (1963) 378; Kew Bull. 18 (1964) 46. — Fig. 6.

Terrestrial. *Rhizoids* numerous, capillary, with papillose branches *c.* 0.5 mm long. *Stolons* few capillary branched. *Foliar organs* on the stolons, linear, membranous, up to 1 cm long, *c.* 1 mm wide, 1-nerved, apex rounded or subacute. *Traps* on the vegetative organs, globose, 0.6–1 mm long, shortly stalked, mouth basal, upper lip with 2 simple subulate recurved appendages, lower lip with 1 shorter truncate or shortly bifid usually apically glandular appendage. *Inflorescence* twining, 3–35 cm long; peduncle filiform, terete, glabrous; flowers 1–8, distant, with 1 or 2 sterile bracts on the internodes; scales few, similar to the bracts; bracts broadly ovate-deltoid, acute or acuminate, 1–1.5 mm long, nerveless; bracteoles linear-lanceolate, about as long as the bract, nerveless; pedicels erect, filiform, narrowly winged, about as long as the flowering calyx. *Calyx lobes* subequal, ovate or broadly ovate, 2.5–3 mm long at anthesis, up to 5 mm long in fruit, upper slightly larger, apex shortly acuminate, lower with apex shortly bi- or tridentate. *Corolla* yellow, 5–10 mm long, upper lip oblong, usually shorter and narrower than upper calyx lobe, apex rounded, entire or emarginate or \pm bifid, lower lip larger, \pm orbicular, apex rounded, entire or 2–3-crenate, palate \pm raised, smooth or 2–4-gibbous, spur subulate, acute, curved, longer than and widely diverging from the lower lip. *Filaments* linear, \pm straight, anther thecae \pm confluent. *Ovary* ovoid, style short, indistinct, stigma lower lip semi-orbicular, upper lip similar, smaller. *Capsule* oblong-ovoid, dorsiventrally compressed, membranous, 2–2.5 mm long, dehiscent by a single ventral longitudinal marginally thickened slit. *Seeds* numerous, broadly ellipsoid or ovoid, *c.* 0.2 mm long, testa thin, smooth, reticulate, reticulations elongate, hilum lateral, prominent.

Distr. Tropical Africa, South Africa, Madagascar, India, Indo-China, through Malesia to N. Australia; in *Malesia*: a single record from Malay Peninsula (G. Ledang) and more widespread in New Guinea and the adjacent Aru Is.

Ecol. Damp places twining up grasses, in Malaya at 1200 m, ascending in New Guinea from the lowland to 2700 m. *Fl.* April–Aug.

6. *Utricularia heterosepala* BENJ. *Linnaea* 20 (1847) 310; MIQ. *Fl. Ind. Bat.* 2 (1859) 1000; VIDAL, *Rev. Pl. Vasc. Filip.* (1886) 200; MERR. *En. Philip.* 3 (1923) 466. — Fig. 7.

Terrestrial. *Rhizoids* few, capillary, basally thickened, with numerous papillose branches *c.* 0.5 mm long. *Stolons* numerous capillary, much branched and mat-forming, up to 15 cm long or more. *Foliar organs* very numerous and conspicuous at anthesis, on the stolons, narrowly ovate or elliptic, membranous, 1–2 cm long, 2–3 mm wide, apex rounded, multinerved. *Traps* numerous on the vegetative organs, globose, 1–2 mm long, shortly stalked, mouth basal, upper lip with 2 long simple subulate appendages, lower lip sometimes

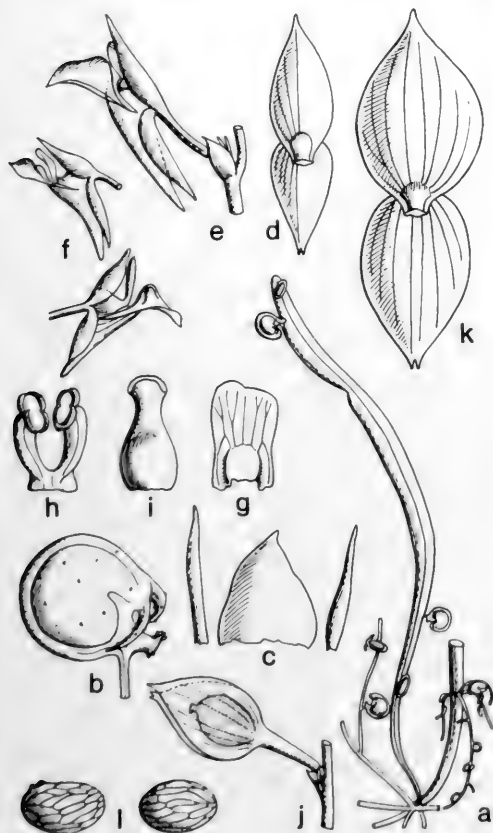


Fig. 6. *Utricularia scandens* BENJ. a. Base of peduncle with rhizoids, foliar organ and traps, $\times 4$, b. trap, $\times 30$, c. bract & bracteoles, $\times 15$, d. calyx, $\times 6$, e. a large flower, $\times 4$, f. two small flowers, $\times 4$, g. upper lip, $\times 6$, h. stamens, $\times 15$, i. pistil, $\times 15$, j. fruit concealed by calyx, $\times 4$, k. fruiting calyx, $\times 6$, l. seeds, $\times 45$ (all after LARSEN 6195, except a and c MILNE-REDHEAD & TAYLOR 8008B).

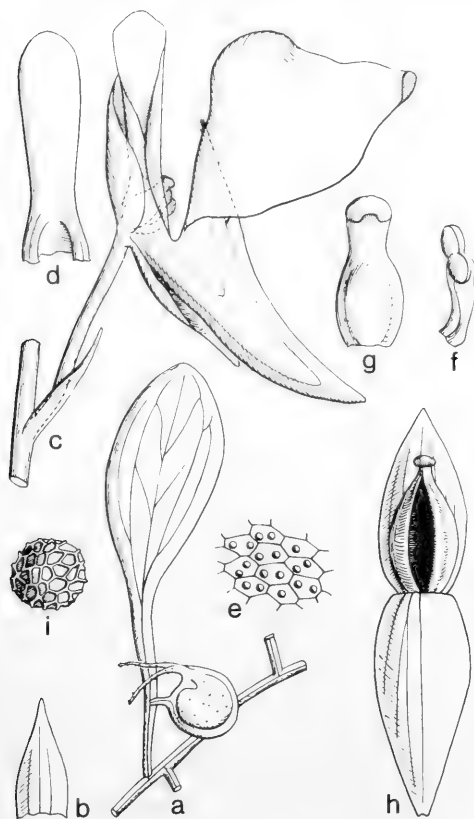


Fig. 7. *Utricularia heterosepala* BENJ. a. Foliar organ with trap, b. bract, c. flower, d. upper lip, all $\times 6$, e. glands inside spur, $\times 45$, f. stamen, $\times 12$, g. pistil, $\times 12$, h. calyx with dehiscent fruit, a thickened area bordering the cleft, $\times 6$, i. seed, $\times 24$ (a-b, h-i ELMER 13127, c-g MERRILL 2085).

with a small \pm obscure lamelliform projection at the distal end of the stalk. Inflorescence erect, 4-15 cm long; peduncle filiform, terete, glabrous; flowers 3-12, distant; scales few, similar to the bracts; bracts basifixed, ovate-deltoid, acute, 2-3 mm long, 3-nerved; bracteoles absent; pedicels erect, filiform, very narrowly winged. Calyx lobes subequal at anthesis, very unequal in fruit, narrowly ovate, both c. 4 mm long at anthesis, apex of upper acute, of lower obscurely bidentate, lower conspicuously accrescent and up to 6 mm long and 2.5 mm wide in fruit. Corolla pink or white, 8-11 mm long, upper lip narrowly oblong or oblong-obovate, about $1\frac{1}{2}$ times as long as upper lobe, apex rounded or truncate, lower lip larger, \pm orbicular, apex rounded, entire or emarginate, palate conspicuously raised, gibbous, spur subulate, acute, curved, longer than and widely diverging from the lower lip. Filaments linear, straight, c. 1 mm long, anther thecae \pm confluent. Ovary ovoid, style short, stigma lower lip quadrate,

deflexed, upper lip much smaller, rounded. Capsule very narrowly ovoid, membranous, c. 3 mm long, dehiscent by a ventral longitudinal marginally thickened slit. Seeds few, globose, c. 0.5 mm long, testa thin, reticulate, reticulations distinct, isodiametric or slightly elongate.

Distr. *Malesia*: Philippines (Palawan, Luzon, and Sibuyan).

Ecol. In wet places on stones in the forest and along streams and creeks at medium and low altitudes (MERRILL). Fl. Febr.-May.

Note. Specimens of this very distinct species (ELMER 13127, Palawan) were dist. ibuted bearing the manuscript name *U. elmeri* STAFF. I can find no evidence of this name ever being published.

7. *Utricularia baouleiensis* A. CHEV. Bull. Soc. Bot. Fr., Mém. 8 (1912, ante Sept. 21); P. TAYLOR in Hutch. & Dalz. Fl. W. Trop. Afr. ed. 2, 2 (1963) 378; Kew Bull. 18 (1964) 69; BACK. & BAKH. f. Fl. Java 2 (1965) 518. — *U. scandens* (non BENJ.) OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 181; CLARKE, Fl. Br. Ind. 4 (1884) 332. — *U. tenerima* MERR. Philip. J. Sc. 7 (1912, Sept. 30) Bot. 247; Fl. Manila (1912) 433; En. Philip. 3 (1913) 467;

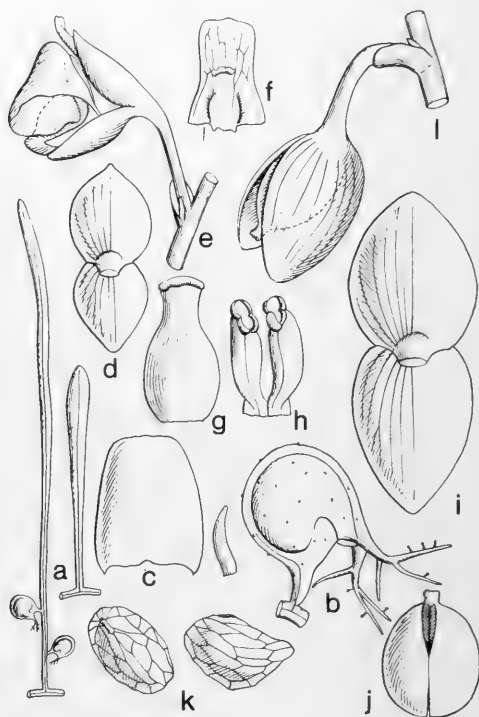


Fig. 8. *Utricularia baouleiensis* A. CHEV. a. Foliar organs, $\times 4$, b. trap, $\times 15$, c. bract & one (of two) bracteoles, $\times 15$, d. calyx, $\times 6$, e. flower, $\times 6$, f. upper lip of corolla, $\times 6$, g. stamens, $\times 15$, h. pistil, $\times 15$, i. calyx flattened, $\times 6$, j. capsule, $\times 6$, k. two seeds, $\times 45$ (all after FAULKNER 269A).

BACK. Onkr. Suiker. (1931) 635; BAKH. *f.* in Back. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 194, p. 3. — Fig. 2a, 8.

Terrestrial. *Rhizoids* few, capillary, with numerous papillose branches *c.* 0.5 mm long. *Stolons* few, capillary branched, up to 5 cm long. *Foliar organs* usually not conspicuous at anthesis, on the stolons, linear, membranous, up to 3 cm long, 0.4–1 mm wide, apex acute or rounded, 1-nerved. *Traps* few on the stolons and foliar organs, globose, 0.8–1.2 mm long, shortly stalked, mouth basal, upper lip with 2 filiform-subulate sparsely branched appendages. *Inflorescence* twining, up to 20 cm long; peduncle capillary, terete, glabrous; flowers 2–5, very distant; scales few, similar to the bracts; bracts ovate to ovate-oblong, *c.* 1.2 mm long, nerveless, apex obtuse to shortly acuminate; bracteoles linear-lanceolate, acute, \pm straight, about half as long as the bract, nerveless; pedicels erect at anthesis, sharply reflexed in fruit, about as long as the calyx, filiform, dorsiventrally flattened and narrowly winged. *Calyx lobes* subequal, ovate, obtuse to subacute, *c.* 2 mm long at anthesis, 3.5–4 mm long in fruit. *Corolla* pale blue or mauve, 3–4 mm long, upper lip oblong, apex truncate, slightly longer than the upper calyx lobe, lower lip larger, \pm orbicular, apex obscurely 3-crenate, palate scarcely raised, spur narrowly conical, obtuse, longer than and \pm diverging from the lower lip. *Filaments* linear, \pm straight, anthers *c.* 0.3 mm long, thecae subdistinct. *Ovary* ovoid, style short, distinct, stigma lower lip orbicular, upper much shorter, truncate. *Capsule* broadly ovoid, dorsiventrally compressed, membranous, dehiscing by a longitudinal ventral marginally thickened slit. *Seeds* numerous, ovoid or ellipsoid, *c.* 0.3 mm long, testa loose, corky, distinctly reticulate, reticulations elongate.

Distr. Scattered in tropical Africa from Mali to Mozambique, in Madagascar, India, China (Hainan), Thailand, and Malesia to Queensland; in *Malesia*: E. Java (Madura: Lampek), Philippines (Luzon).

Ecol. Damp places twining up grasses, in Madura abundant in rice-fields. *Fl.* March, Sept.

Note. This extremely widespread and distinct but very inconspicuous species is probably much commoner than the few specimens seen (less than 20) would suggest. Despite the wide geographical range the Queensland examples (and all from intermediate localities) are identical in every respect with those from West Africa.

8. *Utricularia chrysantha* R. Br. Prod. Nov. Holl. (1810) 432; BTH. Fl. Austr. 4 (1869) 527; F. M. BAILEY, Queensl. Fl. 4 (1901) 1127; EWART & DAVIES, Fl. North. Terr. (1917) 249; SPECHT, Arnheim Land Exped. 3 (1958) 301. — Fig. 9.

Terrestrial. *Rhizoids* numerous, capillary, with numerous short papillose branches. *Stolons* few, capillary, sparsely branched. *Foliar organs* not usually conspicuous at anthesis, on the stolons, narrowly linear, up to 3 cm long and 0.7 mm wide, 1-nerved. *Traps* few on the stolons and foliar organs, obliquely ovoid, 0.4–0.7 mm long, sessile, mouth lateral, upper lip with a prominent dorsiventrally flattened, apically rounded appendage fringed with long unicellular setae, lower lip with a shorter appendage fringed with shorter setae.

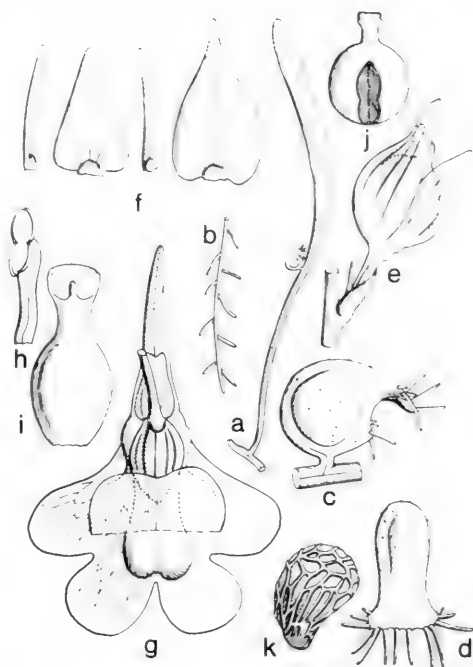


Fig. 9. *Utricularia chrysantha* R.Br. a. Foliar organ, $\times 6$, b. part of rhizoid, $\times 6$, c. trap, lateral view, $\times 24$, d. *ditto*, dorsal view, $\times 24$, e. fruit in calyx, $\times 6$, f. bract, bracteoles & (on right) scale, $\times 12$, g. flower with upper lip half bent back, $\times 12$, h. stamen, $\times 4$, i. pistil, $\times 12$, j. capsule, ventral view, $\times 6$, k. seed, $\times 75$ (a-d, f-j ADAMS 1737, e GEORGE 12231, k PULLEN 7136).

Inflorescence erect, up to 55 cm long (–63 *fide* PULLEN); peduncle filiform, terete, glabrous throughout or minutely papillose at the base; flowers 1–15, distant; scales numerous, especially below, similar to the bracts; bracts basifixed, ovate-deltoid, 1–1.5 mm long, base shortly auriculate, apex acute or acuminate, 1–3-nerved; bracteoles linear-subulate, acute, 0.6–1 mm long; pedicels erect, *c.* 1.5 mm long, terete. *Calyx lobes* unequal, upper broadly ovate, cucullate, *c.* 2.5 mm long, apex rounded, scarcely accrescent, nerves *c.* 9, plicate, lower narrowly ovate, about as long, apex emarginate, 5-nerved. *Corolla* bright yellow with an orange palate and externally tinged with reddish brown, *c.* 10 mm long, upper lip \pm orbicular, apex retuse, longer than upper calyx lobe, lower lip much larger, \pm orbicular in outline, apex \pm deeply 4-lobed, palate prominent, bigibbous, spur subulate, curved, acute, about as long as the lower lip and diverging from it at an angle of *c.* 90°. *Filaments* linear, *c.* 1.5 mm long, anthers *c.* 1 mm long, *c.* 0.3 mm wide, thecae distinct. *Ovary* ovoid, style short but distinct, stigma lower lip orbicular, upper minute, deltoid. *Capsule* globose, *c.* 2 mm long, firm and relatively thick, dehiscing by a ventral narrowly linear lanceolate pore. *Seeds* numer-

ous, obovoid, *c.* 0.25 mm long, hilum terminal, distinct, testa thin, reticulate, reticulations slightly elongate.

Distr. Australia (northern W. Australia, Northern Territory and Queensland) and Malesia: New Guinea (Papua).

Ecol. Sandy open heathland and in *Melaleuca-Acacia* savanna, at low altitude. Fl. June–Aug.

Note. This well known Australian species has been discovered (as has *U. muelleri*) in a number of localities in Papua relatively recently. It is possible that other smaller and less conspicuous Australian species may yet be found in the same region.

9. *Utricularia minutissima* VAHL, Enum. 1 (1804) 204; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 190; RIDL, Trans. Linn. Soc. Lond. II, Bot. 3 (1892) 327; J. Bot. 33 (1895) 11; PRAIN, J. As. Soc. Beng. 74, ii (1905) 371; RIDL, Fl. Mal. Pen. 2 (1923) 492; HEND. J. Mal. Br. R. As. Soc. 17 (1939) 60; SPARE, Mal. Nat. J. 1 (1940) 89; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 531. — *U. pygmaea* R. BR. Prod. (1810) 432; non BTH. Fl. Austr. 4 (1869) 526, *quae est U. exoleta*. — *U. capillacea* (non WILLD.) WALL. Cat. (1832) n. 6399; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 184; THW. En. Pl. Zeyl. (1860) 171; TRIMEN, Handb. Fl. Ceyl. 3 (1895) 270. — *U. siamensis* OSTENF. in Fedde, Rep. 2 (1906) 68; PELLEGR. Fl. Gén. I.-C. 4 (1930) 480. — *U. nipponica* MAKINO, Bot. Mag. Tokyo 20 (1906) 95; OHWI, Fl. Japan (1965) 814. — *U. nigricaulis* RIDL, J. Linn. Soc. Lond. Bot. 38 (1908) 317; J. Fed. Mal. St. Mus. 6 (1915) 164; Fl. Mal. Pen. 2 (1923) 493; SYMINGTON, J. Mal. Br. R. As. Soc. 14 (1936) 357. — *U. calliphysa* STAFF in Gibbs, J. Linn. Soc. Lond. Bot. 42 (1914) 115; MERR. En. Born. (1921) 537; SPECHT, Arnhem Land Exped. 3 (1958) 300. — *U. brevibrabis* LACE, Kew Bull. (1915) 404; PELLEGR. Fl. Gén. I.-C. 4 (1930) 481, incl. *var. parviflora*. — *U. lilliput* PELLEGR. Bull. Mus. Nat. Hist. Paris 26 (1920) 181; Fl. Gén. I.-C. 4 (1930) 482; SUBRAMANYAM & BALAKRISHNAN, Bull. Bot. Surv. India 2 (1960) 347. — *U. evrardii* PELLEGR. Fl. Gén. I.-C. 4 (1930) 476. — *U. barnesii* LLOYD, The Carnivorous Plants (1942) 232, *nomen*. — Fig. 10.

Terrestrial. Rhizoids few, capillary, simple. Stolons capillary, sparsely branched. Foliar organs sparsely rosulate and on the stolons, narrowly linear to narrowly obovate-spathulate, up to 2 cm by 0.5–1 mm, apex obtuse, 1-nerved. Traps numerous on the vegetative organs, broadly ovoid, *c.* 0.2 mm long, stalked, mouth lateral, upper lip with a solitary multicellular subulate appendage, lower lip with radiating rows of basally connate obliquely gland-tipped processes. Inflorescence erect, 3–12 cm long, glabrous or with a few short septate hairs on the peduncle; peduncle terete, filiform; flowers 1–10, distant; scales numerous, similar to the bracts; bracts basifixed, narrowly ovate, acute, 0.8–1 mm long; bracteoles similar or less acute; additional bracts subtending dormant (inflorescence branch) buds usually present on inflorescence axis a short distance above each or most of those subtending flowers; pedicels erect, capillary terete, *c.* 1 mm long. Calyx lobes subequal, broadly ovate, 1–2 mm long, apex of upper obtuse, of lower emarginate, nerves obscure, not raised. Corolla mauve or white, 2.5–7 mm long,

upper lip narrowly oblong, much longer than upper calyx lobe, apex emarginate or rounded, lower lip larger, ± orbicular, obscurely to distinctly 3-lobed, palate raised, spur subulate, obtuse, straight, usually much longer than and parallel with the lower lip. Filaments linear curved, anther thecae ± confluent. Ovary ovoid, style short, stigma lower lip orbicular, upper lip much smaller, deltoid.

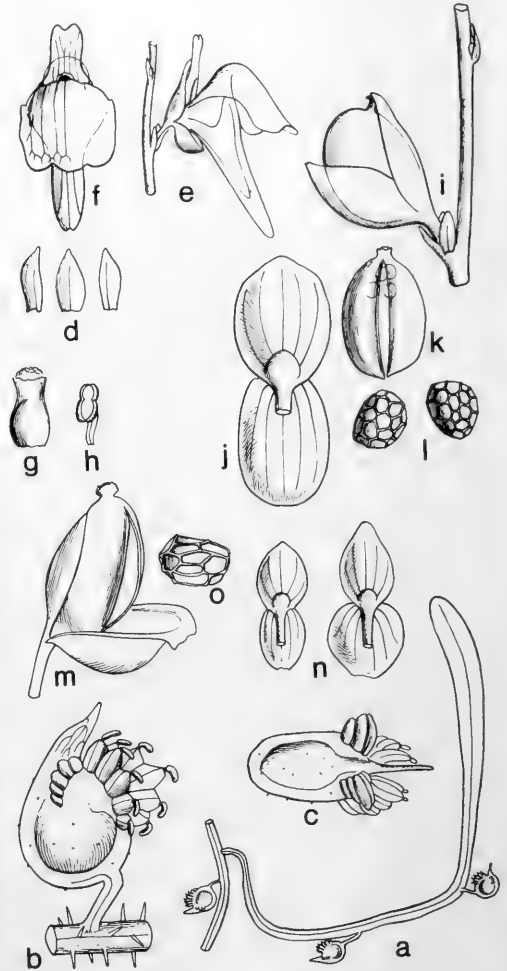


Fig. 10. *Utricularia minutissima* VAHL. a. Stolon with traps and foliar organ, $\times 12$, b. trap, $\times 75$, c. ditto, dorsal view, $\times 75$, d. bract & bracteoles, $\times 12$, e. flower, lateral view, $\times 6$, f. ditto, frontal view, $\times 6$, g. pistil, $\times 12$, h. stamen, $\times 12$, i. capsule, asymmetric in lateral view, $\times 12$, j. fruiting calyx, $\times 12$, k. dehiscent capsule, $\times 12$, l. seeds, $\times 45$, m. dehiscent capsule, $\times 12$, n. flowering (left) and fruiting calyxes, $\times 6$, o. seed, $\times 45$ (a–c MEIJER 26395, d–l J. RAYNALL 17295, m–o MEIJER 26395).

Capsule obliquely oblong-ovoid, 1.5–2 mm long, membranous in texture, translucent, dehiscing by a longitudinal ventral slit which is marginally scarcely thickened. *Seeds* few globose, 0.17–0.2 mm long, testa smooth, reticulate, reticulations relatively large, \pm isodiametric.

Distr. India to China and Japan, Indo-China, Malesia, and Australia (Northern Territory and Queensland); in *Malesia*: Sumatra, Malaya, Borneo, Philippines, and New Guinea.

Ecol. Damp open sandy or rocky places and peaty swamps, also found on wet limestone, mostly at low altitude but ascending to 2100 m on G. Tahan (Malaya). *Fl.* March–Dec.

Note. This species is very variable in overall and in flower size, and the degree to which the lower corolla lip is lobed. The peduncle varies from quite glabrous to sparsely hairy but the hairs when present do not extend to the calyx as in *U. hirta*. The 'rigid patent black bristly hairs' mentioned by PRIN and often present are in fact not hairs but fungal growths.

10. *Utricularia hirta* KLEIN ex LINK, Jahrb. 1, 3 (1820) 55; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 183; CLARKE, Fl. Br. Ind. 4 (1884) 332;

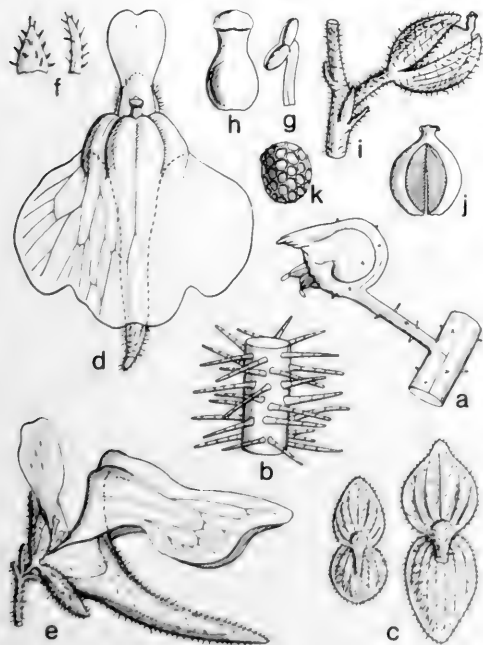


Fig. 11. *Utricularia hirta* KLEIN ex LINK. a. Trap, $\times 75$, b. part of hairy peduncle, $\times 24$, c. flowering calyx (left) and fruiting calyx, d. flower, e. ditto, lateral view, all $\times 6$, f. bract & bracteole, g. stamen, h. pistil, all $\times 12$, i. calyx with fruit, $\times 6$, j. capsule, thickened area shaded, $\times 6$, k. seed, $\times 45$ (all after SMITINAND & WARNECKE s.n., except e G. TAYLOR s.n.).

PELLEGR. Fl. Gén. I.–C. 4 (1930) 479, incl. var. *elongata*; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 531. — *U. capillacea* (non WILLD.) VAHL, Enum. 1 (1804) 204. — *U. setacea* (non MICHX.) WALL. Cat. (1832) n. 6398. — **Fig. 11.**

Terrestrial. *Rhizoids* few, capillary, simple. *Stolons* capillary, sparsely branched. *Foliar organs* sparsely rosulate and on the stolons, narrowly obovate-spathulate, up to 2 cm by 0.5–1 mm, apex obtuse, 1-nerved. *Traps* numerous on the vegetative organs, broadly ovoid, c. 0.2 mm long, stalked, mouth lateral, upper lip with a solitary multicellular subulate appendage, lower lip with radiating rows of basally connate obliquely gland-tipped processes. *Inflorescence* erect, 8–30 cm long, \pm densely covered throughout (including the calyx and at least the spur of the corolla) with short to long septate hairs; peduncle filiform, terete; flowers 1–5, distant; scales numerous, similar to the bracts; bracts basifixed, narrowly ovate, acute, 1–1.2 mm long; bracteoles slightly narrower and longer; additional bracts subtending dormant (inflorescence branch) buds usually present on inflorescence axis a short or very short distance above each or most of those subtending flowers; pedicels erect, capillary, terete, 1–2 mm long. *Calyx lobes* subequal, broadly ovate, 2–3.5 mm long, upper slightly smaller, apex obtuse, nerves raised, lower relatively broader, apex emarginate or obscurely tridentate. *Corolla* mauve or white, 8–10 mm long, upper lip narrowly oblong, much longer than upper calyx lobe, apex \pm emarginate, lower lip larger, \pm orbicular, distinctly 3-lobed, palate raised, spur subulate, acute apically curved, usually longer than and \pm parallel with the lower lip. *Filaments* linear, curved, anther thecae distinct. *Ovary* ovoid, style short but distinct, stigma lower lip orbicular, upper lip much smaller, deltoid. *Capsule* oblong-ovoid to globose, 1.5–2.5 mm long, firm in texture, opaque, dehiscing by a longitudinal ventral marginally thickened slit. *Seeds* few, \pm globose, c. 0.25 mm long, testa smooth, reticulate, reticulations relatively large, slightly elongate.

Distr. India, Indo-China, Thailand and *Malesia*: Borneo (Bako National Park).

Ecol. Damp open sandy or muddy places at low altitude. *Fl.* Febr., July.

Note. Very similar to *U. minutissima* (with which it sometimes occurs) but distinguished by its larger size, larger flowers and hairy calyx.

11. *Utricularia caerulea* LINNÉ, Sp. Pl. (1753) 18; BURM. f. Fl. Ind. (1768) 11; WIGHT, Ic. (1850) t. 1583; GAMBLE, Fl. Madras 2 (1924) 983; SANTAPAU, J. Bomb. Nat. Hist. Soc. 49 (1950) 217; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 530. — *U. nivea* VAHL, Enum. 1 (1804) 203; WIGHT, Ic. (1850) t. 1582; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 186; MERR. Fl. Manila (1912) 433; Philip. J. Sc. 7 (1912) Bot. 247; En. Philip. 3 (1923) 466; BACK. Onkr. Suiker. (1931) 636; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 194, p. 3; BACK. & BAKH. f. Fl. Java 2 (1965) 518. — *U. baueri* R. BR. Prod. Nov. Holl. (1810) 431; BTH. Fl. Austr. 4 (1869) 531; SPECHT, Arnhem Land Exped. 3 (1958) 300. — *U. complanata* WALL. Cat. (1829) n. 1497, nomen. — *U. racemosa* WALL. ex WALP. in Meyen, Observ. Bot. Nov. Acta 19

(1843) 401; A. DC. in DC. Prod. 8 (1844) 21; WIGHT, Ic. (1850) t. 1584(1); OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 186; CLARKE, Fl. Br. Ind. 4 (1884) 333; FORBES & HEMSL. J. Linn. Soc. Lond. Bot. 26 (1890) 224; RIDL. Trans. Linn. Soc. Lond. II, Bot. 3 (1893) 327; J. Str. Br. R. As. Soc. n. 33 (1900) 119; *ibid.* n. 59 (1911) 144; STAPP in Gibbs, Arfak (1917) 180; MERR. Lingn. Sc. J. 5 (1927) 167; MELCHIOR, Bot. Jahrb. 62 (1929) 383; PELLEGR. Fl. Gén. I.-C. 4 (1930) 485; HAND.-MAZZ. Symb. Sin. 7 (1936) 873; MERR. J. Agr. Arb. 18 (1937) 73; SPARE, Mal. Nat. J. 1 (1940) 90. — *U. filicaulis* WALL. (Cat. 1829, n. 1501) ex A. DC. in DC. Prod. 8 (1844) 21; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 186; MIQ. Fl. Ind. Bat. 2 (1859) 999; PELLEGR. Fl. Gén. I.-C. 4 (1930) 486, *incl. var. papillosa*. — *U. bifida* (non L.) MACRAE ex A. DC. in DC. Prod. 8 (1844) 21, *pro syn.* — *U. squamosa* BENJ. Bot. Zeit. 3 (1845) 212. — *U. rosea* EDGEW. Proc. Linn. Soc. Lond. 1 (1847) 352. — *U. purpurea* (non WALT.) WILLD. ex BENJ. Linnaea 20 (1847) 309, *pro syn.* — *U. paucifolia* BENJ. l.c. 309. — *U. obtusiloba* BENJ. l.c. 312. — *U. albiflora* (non R. Br.) GRIFF. Notul. 4 (1854) 168. — *U. racemosa* var. *filicaulis* CLARKE, Fl. Br. Ind. 4 (1884) 333; BOERL. Handl. 2, 2 (1899) genus 559; PRAIN, J. As. Soc. Beng. 74, ii (1905) 373; MERR. En. Born. (1921) 538. — *U. campestris* MIQ. ex CLARKE, Fl. Br. Ind. 4 (1884) 333, *pro syn.* — *U. warburgii* GOEBEL, Ann. Jard. Bot. Btzg 9 (1891) 22. — *U. ophirensis* RIDL. J. Bot. 33 (1895) 10; PRAIN, J. As. Soc. Beng. 74, ii (1905) 373; RIDL. Fl. Mal. Pen. 2 (1923) 495, f. 122; PELLEGR. Fl. Gén. I.-C. 4 (1930) 487. — *U. cavalerii* STAPP, Kew Bull. (1910) 195. — *U. sootepensis* CRAIB, Kew Bull. (1911) 430; PELLEGR. Fl. Gén. I.-C. 4 (1930) 487. — *U. kerrii* CRAIB, Kew Bull. (1911) 429; PELLEGR. Fl. Gén. I.-C. 4 (1930) 485. — *U. charnleyensis* FITZGERALD, J. R. Soc. W. Austr. 3 (1918) 207. — *U. albina* RIDL. Fl. Mal. Pen. 2 (1923) 493; HEND. Gard. Bull. S. S. 4 (1928) 295. — *U. roseo-purpurea* STAPP ex GAMBLE, Fl. Madras 2 (1924) 983. — Fig. 12.

Terrestrial. *Rhizoids* few to very numerous, capillary, simple. *Stolons* capillary, sparsely branched. *Foliar organs* not always conspicuous at anthesis, rosulate and on the stolons, narrowly obovate-spathulate, up to 7 mm long and 1.5 mm wide, apex rounded, 1-nerved. *Traps* rather few on the vegetative organs, \pm dimorphic, ovoid, shortly stalked, mouth terminal, oblique, the larger traps up to 1.5 mm long including a long carinate beak on the upper lip, the smaller traps about half as long with a relatively shorter beak, mouth and beak of both types densely stipitate-glandular. *Inflorescence* erect, 5–30 cm long; peduncle filiform to relatively stout, 0.3–1.5 mm thick, terete, glabrous; flowers 1–20 or more very variably disposed, distant to quite densely congested and subcapitate; scales numerous, similar to the bracts; bracts medifixed, variably attached above or below the middle, narrowly rhombic, acuminate at both extremities, 2–2.5 mm long; bracteoles similar but often shorter and narrower; pedicels erect at anthesis, spreading or reflexed in fruit, filiform, terete, 0.5–1 mm long. *Calyx lobes* unequal, usually minutely papillose, upper ovate-oblong, cucullate, 2–3 mm long, apex rounded, lower shorter, transversely elliptic with conspicuously

inrolled margins. *Corolla* pink, mauve, purple or blue, often white and sometimes? yellow, 4–10 mm long, externally minutely papillose, upper lip narrowly ovate-oblong, longer than upper calyx lobe, apex rounded or truncate, lower lip larger, \pm orbicular, apex retuse, palate raised, \pm conspicuously transversely crested, spur narrowly conical or cylindrical from a broader conical base, straight or curved, usually longer than and \pm parallel with the lower lip. *Filaments* filiform, straight, c. 1 mm long, anther thecae distinct, minutely papillose. *Ovary* ovoid, style variably in length, usually distinct, stigma lower lip orbicular, upper



Fig. 12. *Utricularia caerulea* L. a. Foliar organ, $\times 6$, b. large and small trap, $\times 24$, c. bract & bracteoles, all peltately attached, $\times 6$, detail of surface papillae, $\times 24$, d. calyx in flower, $\times 6$, detail of surface papillae, $\times 24$, e. flower, lateral view, and upper lip from front, f. flower, front view, g. small flower, all $\times 6$, h. stamen, $\times 12$, i. pistil, $\times 12$, j. calyx with fruit, $\times 6$, k. fruit exposed, $\times 6$, l. seed, $\times 45$, with detail of testa enlarged, $\times 75$ (all after J. RAYNAL 17069, large form, except a-b, d, g LARSEN 5160, small form).

lip minute, deltoid. *Capsule* globose, c. 2 mm long, firm, opaque, dehiscing by a ventral longitudinal slit. *Seeds* numerous, obliquely oblong-ellipsoid, c. 0.3 mm long, testa thin, smooth to distinctly papillose, obscurely reticulate, reticulations elongate.

Distr. India to China and Japan and Australia; in *Malesia*: not recorded from the Lesser Sunda Is. (but present in Kangean Is.) or Celebes, but otherwise widespread and common.

Ecol. Damp or wet open situations on sand (also on kerangas and in heath-forest) or mud both under everwet and seasonal climatic conditions, from sea-level to 2700 m. *Fl.* Jan.-Dec.

Note. This is an excessively variable plant in which the extreme forms, often of quite distinct appearance, are linked by intermediates.

12. *Utricularia striatula* J.Sm. in Rees, Cyclop. 37 (1819) n. 17; FORBES & HEMS. J. Linn. Soc. Lond. Bot. 26 (1890) 224; GOEBEL, Ann. Jard. Bot. Btzig 9 (1890) 68; RIDL. Fl. Mal. Pen. 2 (1923) 495; GAMBLE, Fl. Madras 2 (1924) 983; PELLEGR. Fl. Gén. I.-C. 4 (1930) 474; HAND.-MAZZ. Symb. Sin. 7 (1936) 872; SPARE, Mal. Nat. J. 1 (1940) 88; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 194, p. 2; SANTAPAU, J. Bomb. Nat. Hist. Soc. 49 (1950) 220; P. TAYLOR in Hutch. & Dalz. Fl. W. Trop. Afr. ed. 2, 2 (1963) 378; Kew Bull. 18 (1964) 91; BACK. & BAKH. f. Fl. Java 2 (1965) 517; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 532. — *U. pusilla* (non VAHL) GRAH. Cat. Pl. Bombay (1839) 165. — *U. orbiculata* WALL. (Cat. 1829, n. 1500) ex A. DC. in DC. Prod. 8 (1844) 18; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 187; CLARKE, Fl. Br. Ind. 4 (1884) 334; STAPP, Trans. Linn. Soc. Lond. II, Bot. 4 (1894) 211; TRIMEN, Handb. Fl. Ceyl. 3 (1895) 271; RIDL. J. Str. Br. R. As. Soc. n. 59 (1911) 144; MERR. En. Born. (1921) 538; En. Philip. 3 (1923) 467; STEEN. Arch. Hydrobiol. Suppl. 11 (1932) 333, f. 8 IV; H. J. LAM, Blumea 5 (1945) 582. — *U. rosulata* BENJ. Linnaea 20 (1847) 310; MIQ. Fl. Ind. Bat. 2 (1859) 1000; MERR. En. Philip. 3 (1923) 189. — *U. glochidiata* WIGHT, Ic. (1850) t. 1581. — *U. harlandii* OLIVER ex BTH. Fl. Hongk. (1861) 257; FORBES & HEMS. J. Linn. Soc. Lond. Bot. 26 (1890) 223. — *U. anthropophora* RIDL. J. Fed. Mal. St. Mus. 6 (1915) 165. — *U. striatula* var. *minor* RIDL. Trans. Linn. Soc. Lond. II, Bot. 9 (1916) 122; MELCHIOR, Bot. Jahrb. 62 (1929) 384. — Fig. 2e, 13-14.

Epiphytic or terrestrial. *Rhizoids* few, capillary, simple. *Stolons* capillary, branched. *Foliar organs* numerous and conspicuous at anthesis, rosulate and on the stolons, obovate, orbicular or reniform with a \pm distinct pseudopetiole, membranous, 3-10 mm long, up to 6 mm wide, with numerous dichotomously branched nerves. *Traps* numerous on the stolons, obliquely globose or ovoid, 0.6-0.8 mm long, long stalked, mouth lateral, upper lip projecting with 2 divergent stipitate-glandular appendages. *Inflorescence* erect, 1-15 cm long; peduncle filiform, glabrous, usually less than 0.3 mm thick; flowers 1-10, distant; scales few, similar to the bracts; bracts medifixed, lanceolate, apex obtuse or acute, base truncate to acute; bracteoles similar; pedicels spreading at anthesis, \pm reflexed in fruit, capillary, usually less than 0.2 mm thick. *Calyx lobes* very unequal, papillose,

upper orbicular-obcordate, 1.5-2.5 mm long at anthesis, apex emarginate, lower very much smaller, ovate-oblong, apex truncate or retuse. *Corolla* white, pink or mauve with a yellow spot on the palate, 3-10 mm long, upper lip minute, semi-orbicular, apex bidentate, very much shorter than the upper calyx lobe, lower lip orbicular or transversely elliptic, 3-10 mm wide, apex \pm distinctly 3-5-lobed, palate slightly raised, spur subulate,

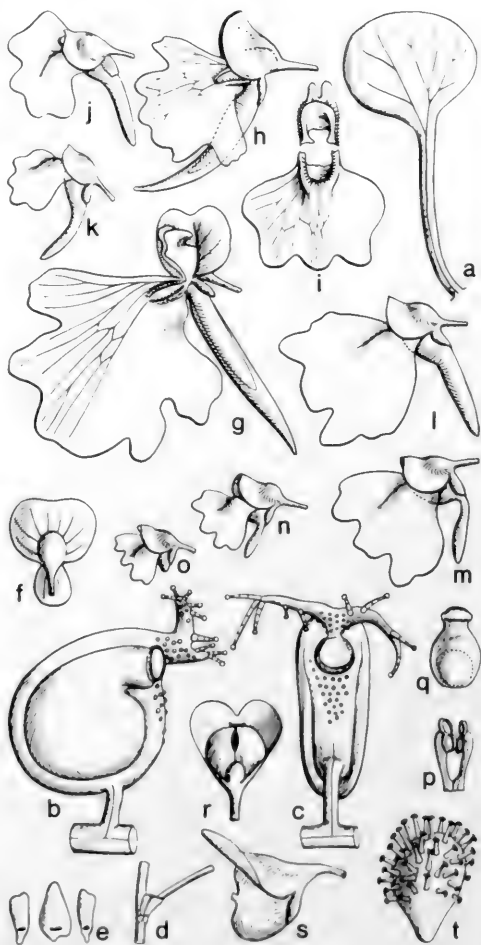


Fig. 13. *Utricularia striatula* J.Sm. a. Foliar organ, $\times 6$, b-c. trap, lateral & ventral views, $\times 24$, d. insertion of pedicel, with bract & bracteoles *in situ*, $\times 6$, e. the latter enlarged, $\times 12$, f. calyx in flower, $\times 6$, g. flower calyx lobe bent back to show upper corolla lip, $\times 5$, h. *ditto*, in lateral view, $\times 5$, i. upper & lower lip flattened, $\times 6$, j-k. two flowers, $\times 5$, l-o. four *ditto*, $\times 5$, p. stamens, $\times 12$, q. pistil, $\times 12$, r. dehiscing fruit, $\times 6$, s. fruit in lateral view, $\times 6$, t. seed, $\times 45$ (a-c, g-h, r-t ALLEN s.n., Borneo, f, l-q J. RAYNAL 16843, d-e, i-k CRUTTZWELL 201).



Fig. 14. *Utricularia striatula* J.Sm. Epiphytic on a tree trunk in primary forest on sandstone at Lubuk Bangko, 20 km E of Pajakumbuh, Central West Sumatra, Febr. 2, 1957. Photogr. W. MEIJER. Note orbicular foliar organs at right margin.

usually curved, 1–4 mm long, shorter than and \pm parallel with or somewhat divergent from the lower lip. *Filaments* filiform, *c.* 0.6 mm long, anther thecae subdistinct. *Ovary* globose, style short but distinct, stigma lower lip semi-orbicular, upper obsolete. *Capsule* \pm globose, obliquely dorsiventrally compressed, membranous, obscurely ventrally keeled, dehiscing by a ventral longitudinal slit. *Seeds* few, pyriform or obovoid, *c.* 0.25 mm long, hilum terminal, prominent, testa smooth, bearing, especially distally, numerous unicellular apically glochidiate processes.

Distr. Tropical Africa (but apparently absent from Madagascar), widespread from India to China, Indo-China and throughout *Malesia*.

Ecol. Rocks or trees or less commonly damp soil among moss in somewhat shady permanently

moist conditions, on mossy tree trunks, on stones in rivers, near waterfalls, on wet talus, from sea-level up to 3300 m. *Fl.* Jan.–Dec.

Vern. Banka: *kakrak*, *rumput kitjekar*, M; New Guinea: *romaripi*, Orne lang., Wantipi.

13. *Utricularia pulchra* P. TAYLOR, *sp. nov.* — Fig. 15.

Affinis *U. striatulae* J.Sm. *sed floribus duplo majoribus, paucioribus in inflorescentia crassiore congestis differt.* — Type: New Guinea, Irian Jaya, Tembagapura (southern slopes of Mt Carstensz), alt. 2400 m, 30 April 1973, RAYNAL 17440 (K, P). — *U. striatula* (non J.Sm.) RIDL. Trans. Linn. Soc.

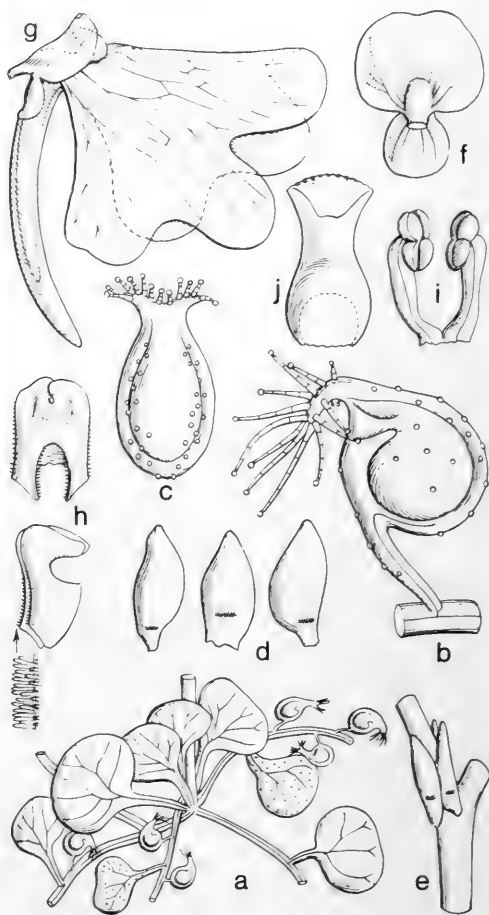


Fig. 15. *Utricularia pulchra* P. TAYLOR. a. Habit of vegetative parts, $\times 4$, b–c. trap, lateral & dorsal views, $\times 24$, d. bract & bracteoles, $\times 8$, e. their insertion, $\times 6$, f. calyx, $\times 4$, g. (large) flower, $\times 3$, h. upper lip, ventral & lateral views, $\times 6$, detail of hairs, $\times 24$, i. stamens, $\times 12$, j. pistil with circular adnation to calyx at base, $\times 12$ (all after J. RAYNAL 17440, type).

Lond. II, Bot. 9 (1916) 122; MELCHIOR, Bot. Jahrb. 62 (1929) 384.

Terrestrial. *Rhizoids* few, capillary, simple. *Stolons* few, capillary, up to 5 cm long. *Foliar organs* present at anthesis, rosulate and on the stolons, reniform, fleshy, \pm pseudopetiolate, 2–4 mm long. *Traps* numerous on the stolons, globose, 0.6–1 mm long, stalked, mouth lateral, upper lip projecting, with 2 short divergent stipitate-glandular appendages. *Inflorescence* erect, 4–6 cm long; peduncle filiform, glabrous, 0.5–0.7 mm thick; flowers 1–3, congested; scales 1 or 0, similar to the bracts; bracts medifixed, ovate, 1.5–2 mm long, apex obtuse, base truncate or bidentate; bracteoles similar; pedicels erect, filiform, dorsiventrally flattened, 4–5 mm long, c. 0.5 mm wide. *Calyx lobes* very unequal, papillose, upper orbicular or broadly reniform, apex rounded or retuse, 3–4 mm long, 3.5–5 mm wide, lower much smaller, orbicular or broadly ovate, 2–2.5 mm long. *Corolla* mauve or violet with a yellow spot on the palate, 17–20 mm long, upper lip about as long as upper calyx lobe, oblong, cucullate, apex emarginate, lower lip flabellate, 5-lobed, up to 20 mm wide, palate slightly raised, spur subulate, \pm straight, 10–12 mm long, as long as or longer than the lower lip and diverging from it at a very obtuse angle. *Filaments* linear, c. 1.2 mm long, anther thecae distinct. *Ovary* obliquely ovoid, c. 1.5 mm long, style very short, stigma lower lip semi-orbicular, upper lip obsolete. *Capsule* and *seeds* not known.

Distr. *Malesia*: New Guinea (West New Guinea: Mt Carstensz; T.N.G., Sepik Distr.: Sirius Plateau).

Ecol. Wet cliffs and damp leached sand or among moss, 2400–3000 m. *Fl.* March–April, Oct.

Note. *U. pulchra* is very close to *U. striatula* but differs constantly in its fewer, much larger flowers and its shorter stouter habit.

14. *Utricularia salwinensis* HAND.-MAZZ. Symb. Sin. 7 (1936) 873. — Fig. 16.

Terrestrial. *Rhizoids* few, capillary, simple. *Stolons* capillary, sparsely branched, up to 5 cm long. *Foliar organs* present at anthesis, sparsely rosulate and on the stolons, flabellate, cuneate or obovate-spathulate to orbicular, with a distinct pseudopetiole, 1.5–3.5 mm wide, up to 2.5 cm long. *Traps* rather few on the stolons, ovoid, long stalked, c. 0.8 mm long, mouth lateral, upper lip with a relatively large flabellate appendage c. 1 mm long and 2 mm wide including c. 8 marginal subulate multicellular gland-tipped processes. *Inflorescence* erect, up to 8 cm long; peduncle filiform, terete, glabrous; flowers 1–3, \pm distant; scales 0 or 1 in the upper part of the peduncle, similar to the bracts; bracts medifixed, ovate, membranous, sparsely glandular, 1.2–1.5 mm long, apex acute, base truncate, apiculate; bracteoles similar but base obliquely truncate; pedicels erect at anthesis, strongly recurved in fruit, 2–4 mm long. *Calyx lobes* very unequal, papillose, upper \pm orbicular, c. 1.5 mm long at anthesis, up to 3 mm long in fruit, apex emarginate, lower much smaller, ovate-oblong, c. 1 mm long, apex truncate or retuse. *Corolla* white (in Mal.) with a yellow (*sic* DE WILDE) or brown (*sic* VAN STEENIS) spot on the palate or pink (in Yunnan, *sic* HANDEL-MAZZETTI), 4–6 mm long, upper lip transversely

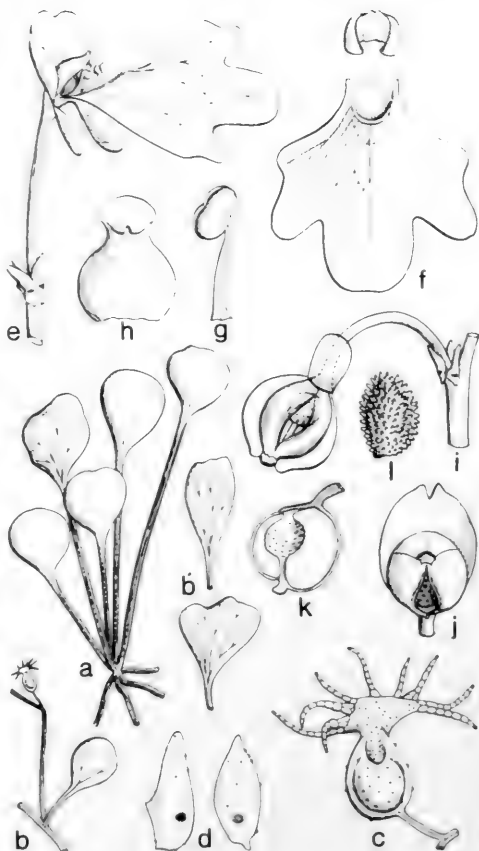


Fig. 16. *Utricularia salwinensis* HAND.-MAZZ. a. Rosette of foliar organs, b. stolon with foliar organ, branch and trap, b'. lamina of two foliar organs, all $\times 3$, c. trap, $\times 12$, d. bract (right) & bracteole, $\times 12$, e. flower, $\times 6$, f. corolla, upper & lower lip laid out, $\times 6$, g. stamen, $\times 24$, h. pistil, $\times 24$, i. dehiscent fruit in calyx, j. ditto, lower calyx lip removed, k. capsule in LS, seeds removed, all $\times 6$, l. seed, $\times 24$ (a VAN STEENIS 8598, the others after DE WILDE 15258).

oblong, cucullate, apex emarginate, much shorter than upper calyx lobe, lower lip flabellate, 4–5 mm wide, 3-lobed, midlobe quadrate or semi-orbicular, side lobes smaller, obliquely and obscurely unequally 2-lobed, palate scarcely raised, shortly fimbriate, spur narrowly cylindrical, apex obtuse, much shorter than the lower lip. *Filaments* filiform, c. 1 mm long, anther thecae distinct. *Ovary* globose, c. 0.6 mm long, style very short, stigma lower lip orbicular, upper lip minute, deltoid. *Capsule* globose, obliquely dorsiventrally compressed, c. 2 mm long, dehiscent by a longitudinal ventral slit. *Seeds* few, ovoid, c. 0.5 mm long, shortly densely echinate.

Distr. China (Yunnan) and *Malesia*: N. Sumatra (Gajo Lands: Mts Goh Lembuh, Kemiri, Bandahara, Mamas, and Losir).

Ecol. Moist sandy rocky or mossy places in open or low scrub, 2500–3300 m. *Fl.* Febr.–May.

Note. The only difference between the Yunnan and Sumatra plants is the recorded corolla colour and this is not considered significant. Similarly disjunct distribution of mountain plants are not unknown.

15. *Utricularia limosa* R. BR. Prod. Nov. Holl. (1810) 432; BTH. *Fl. Austr.* 4 (1869) 531; SPECHT, *Arnhem Land Exped.* 3 (1958) 302. — *U. verticillata* BENJ. *Linnaea* 20 (1847) 312; OLIVER, J. *Linn. Soc. Lond. Bot.* 3 (1859) 184; MIQ. *Fl. Ind. Bat.* 2 (1859) 1000; CLARKE, *Fl. Br. Ind.* 4 (1884) 333; RIDL. *Trans. Linn. Soc. Lond. II, Bot.* 3 (1893) 327; BOERL. *Handl.* 2, 2 (1899) genus 559; PRAIN, J. *As. Soc. Beng.* 74, ii (1905) 372; RIDL. J. *Str. Br. R. As. Soc. n.* 59 (1911) 144; *Fl. Mal. Pen.* 2 (1923) 493; PELLEGR. *Fl. Gén. I.-C.* 4 (1930) 484; SPARE, *Mal. Nat. J.* 1 (1940) 90. — *U. bifida* (non L.) WIGHT, *lc.* (1850) t. 1584(2). — *U. biloba* (non R. BR.) P. TAYLOR, *Dansk Bot. Ark.* 23 (1968) 529. — Fig. 17.

Terrestrial. *Rhizoids* few, filiform, basally thickened, with numerous, often geminate, papillose branches c. 0.5 mm long. *Stolons* capillary, branched. *Foliar organs* often not present or conspicuous at anthesis, on the stolons, narrowly

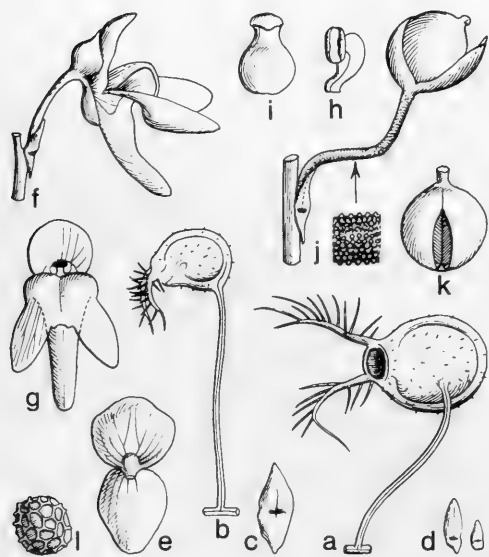


Fig. 17. *Utricularia limosa* R. BR. a–b. Traps, large & small, $\times 12$, c. bract, d. scales, mid and lower (small one), e. fruiting calyx, all $\times 6$, f–g. flower, in two views, $\times 6$, h. stamen, $\times 12$, i. pistil, $\times 12$, j. capsule, $\times 6$, and enlarged surface of pedicel, $\times 24$, k. capsule, ventral view, thickened area shaded, $\times 6$, l. seed, $\times 45$ (a–e, k MUST 1004, the others after J. RAYNAL 17296).

linear, 1.5–2.5 cm long, c. 0.3 mm wide, 1-nerved, apex acute. *Traps* few on the stolons and foliar organs, obliquely ovoid, 0.5–1 mm long, stalked, stalk 2–3 times as long as trap, mouth lateral, upper lip with 2 long densely hairy setiform appendages. *Inflorescence* erect, up to 25 cm long; peduncle filiform, glabrous or basally glandular, 0.5–0.8 mm thick; flowers 2–10, rather distant; scales few, similar to the bracts; bracts medifixed, narrowly elliptic, 1.5–2 mm long, apex acute, base acute or obliquely truncate; bracteoles absent; pedicels filiform, slightly dorsiventrally flattened, minutely papillose, distinctively curved, erect at base and apex, spreading in the middle part, up to 6 mm long in fruit. *Calyx lobes* unequal, upper transversely elliptic, apex rounded, up to 1.5 mm long in fruit, lower obovate-oblong, apex rounded or obscurely crenulate, up to 2 mm long in fruit. *Corolla* violet, pink or white, 4.5–6 mm long, upper lip broadly ovate, about twice as long as upper calyx lobe, apex rounded; lower lip larger, quadrate, bilobed to half its length, lobes ovate-oblong, curved upwards, palate raised, spur narrowly cylindrical from a conical base, apex obtuse, somewhat longer than lower lip. *Filaments* linear, strongly curved, flattened and apically dilated, c. 0.6 mm long, anthers c. 0.3 mm long, thecae confluent. *Ovary* globose, style short, stigma lower lip orbicular, upper lip obsolete. *Capsule* globose, c. 2 mm long, membranous, dehiscent by a longitudinal ventral marginally thickened slit, the thickened area before dehiscence apically acute, broader and emarginate at the base. *Seeds* numerous, globose or slightly angular, c. 0.25 mm long, testa thin, coarsely reticulate, reticulation \pm isodiametric.

Distr. Indo-China, Thailand, and Australia; in *Malesia*: Malay Peninsula and New Guinea.

Ecol. Seasonally flooded grassland at low altitude. *Fl.* Febr.–May, Sept.

NOTE. *U. limosa* belongs to a small, very distinct group of species, the others in the group being apparently confined to Australia.

16. *Utricularia subulata* LINNÉ, Sp. Pl. (1753) 18; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 532. — For full synonymy, which is large and exclusively American and African, see P. TAYLOR, *Kew Bull.* 18 (1964) 81–83 and *Mem. N.Y. Bot. Gard.* 17 (1967) 223. — Fig. 18.

Terrestrial. *Rhizoids* few, capillary, basally thickened and rigid, with numerous papillose branches c. 0.5 mm long. *Stolons* capillary, much branched. *Foliar organs* often not conspicuous at anthesis, narrowly linear, 1–2 cm long, c. 0.5 mm wide, apex acute, 1-nerved. *Traps* very numerous on the vegetative organs, ovoid, stalked, 0.2–0.5 mm long, mouth lateral, upper lip projecting with 2 spreading curved subulate sparsely branched appendages. *Inflorescence* erect, up to 25 cm long; flowers 1–25, moderately distant; peduncle capillary, glabrous above, usually minutely papillose below; scales few, similar to the bracts but narrower and acuminate at base and apex, often papillose; bracts medifixed, peltate, broadly elliptic to orbicular, membranous, 0.75–1 mm long, obtuse or subacute at base and apex; bracteoles absent; pedicels ascending, capillary, terete, 2–10 mm long. *Calyx lobes* subequal, broadly ovate to orbicular,

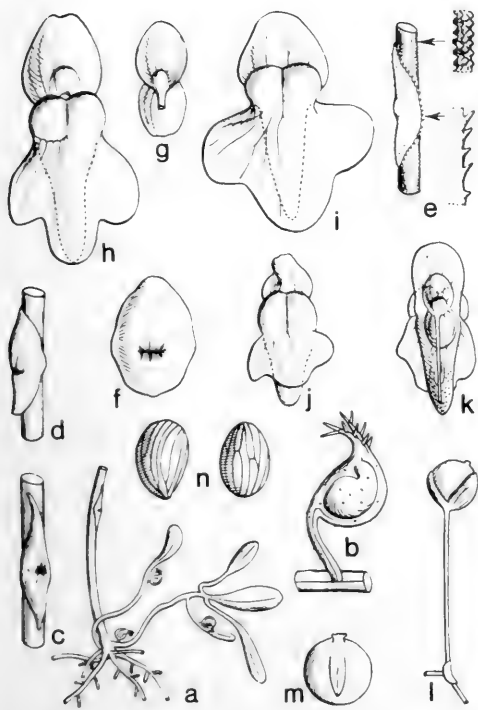


Fig. 18. *Utricularia subulata* L. a. Base of peduncle and vegetative parts, $\times 6$, b. trap, $\times 45$, c. smooth peduncle with lower scale, d. *ditto*, with upper scale, both $\times 12$, e. peduncle near base with papillae and teeth on margin of scale, $\times 15$, with details, $\times 75$, f. bract, flattened, $\times 12$, g. calyx in flower, h-i. corolla, j. *ditto*, small size, k. *ditto*, adaxial aspect, l. fruiting pedicel, m. capsule, ventral view, all $\times 6$, n. two seeds, $\times 45$ (a, j, k LARSEN & WARNCKE 13, b-d, f JACOBS 5494, e, i KERR 14338, g, h FRANCK s.n., l, m MILNE-REDHEAD & TAYLOR 7779B, n MELVILLE & HOOKER 253).

c. 1 mm long at anthesis, slightly accrescent, apex rounded or truncate. Corolla yellow, 6-10 mm long, upper lip broadly ovate to orbicular, 2-3 times as long as upper calyx lobe, apex rounded, lower lip larger, \pm flabellate, deeply 3-lobed, midlobe larger than side lobes, apex of lobes rounded to truncate, palate much raised, gibbous, spur subulate from a short conical base, parallel with and about as long as lower lip, apex usually obtuse, sometimes acute or 2-4-denticulate. Filaments filiform, curved, anther thecae confluent. Ovary globose, style very short, stigma lower lip orbicular, upper lip obsolete. Capsule globose, 1-1.5 mm long, membranous, dehiscing by a small ventral ovate pore. Seeds numerous, ovate, 0.2-0.25 mm long, testa thin, obscurely longitudinally striate.

Distr. Eastern North America, throughout Central and South America to Argentina, through-

out tropical Africa and in S. Africa and Madagascar, also in Portugal (possibly introduced); in Thailand and in Malesia: Malaya (Selangor) and Borneo (Bako National Park, Kalabit Highlands, and once in Central Borneo).

Ecol. Damp open sandy or boggy ground at low altitude. Fl. Sept.

Note. It is curious that this species, which is widespread and abundant in the New World, Africa and Madagascar, should never have been found in India. There can be no doubt that the Malesian plant is the same as the African and American ones.

17. *Utricularia punctata* WALL. (Cat. 1829, n. 2121) ex A. DC. in DC. Prod. 8 (1844) 5; WIGHT, Ic. (1850) t. 1570; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 175; MIQ. Suppl. 1 (1860) 246; KURZ, Nat. Tijds. N. I. 27 (1864) 213; RIDL. Trans. Linn. Soc. Lond. II, Bot. 3 (1893) 327; BOERL. Handl. 2, 2 (1899) genus 559; PRIN, J. As. Soc. Beng. 74, ii (1905) 369; MERR. En. Born. (1921) 538; RIDL. Fl. Mal. Pen. 2 (1923) 491; SPARE, Mal. Nat. J. 1 (1940) 88; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 531, excl. syn. *U. rogersiana*. — *U. fluitans* RIDL. J. Str. Br. R. As. Soc. n. 61 (1912) 32; Fl. Mal. Pen. 2 (1923) 491; Disp. (1930) 180, sphalm. 'fluvialis'. — *U. aurea* (non LOUR.) P. TAYLOR, Dansk Bot. Ark. 23 (1968) 529, quoad syn. *U. fluitans*. — Fig. 19.

Aquatic. Rhizoids apparently absent. Stolons filiform, terete, sparsely branched, up to 20 cm long, 0.5-1 mm thick, glabrous. Foliar organs numerous on the stolons, 2-6 cm long, the primary segment divided in 2 or 3 just above the base, then repeatedly divided into very numerous segments, the secondary pinnae \pm reflexed, the lowermost somewhat remote from the base which may or may not be provided with sparse stipule-like segments resembling the ultimate segments, the latter capillary, terete, sparsely minutely setulose; the primary segments of the foliar organ basal to the inflorescence often longer, inflated, \pm fusiform and bearing fewer shorter ultimate segments. Traps not numerous, lateral on the penultimate and ultimate segments, broadly obliquely ovoid, 1-2 mm long, shortly stalked, mouth lateral with short marginal setae, upper lip with 2 long, branched setiform appendages. Inflorescence erect, 8-30 cm long; peduncle filiform, terete; flowers 6-12, \pm distant; scales few, similar to the bracts; bracts medifixed, peltate, inserted shortly above the base of the pedicel, ovate, apex acute, base rounded, membranous, c. 2 mm long, attached below the middle; bracteoles absent; pedicels capillary, terete, erect or ascending, c. 6 mm long at anthesis, up to 15 mm long in fruit. Calyx lobes subequal, the lower slightly smaller, orbicular, membranous, c. 1.5 mm long, scarcely accrescent. Corolla lilac, violet, pink or rarely white, with a yellow spot on the palate, 6-10(-15) mm long, externally glabrous, upper lip transversely elliptic or orbicular, cucullate, apex rounded, lower lip larger, transversely oblong-elliptic, up to 12 mm wide, base auriculate, apex rounded, lateral margins incurved, palate raised, gibbous, spur conical, slightly curved, apex obtuse, about as long as and \pm parallel with the lower lip. Filaments falcate, considerably expanded above, c. 1.5 mm long, anther thecae confluent. Ovary ovoid, style about as long as ovary,

stigma lower lip orbicular, upper lip much smaller, deltoid. *Capsule* ellipsoid, membranous, c. 3 mm long, laterally bivalvate. *Seeds* few, lenticular, 1.5–2 mm wide, margin winged, deeply irregularly dentate.

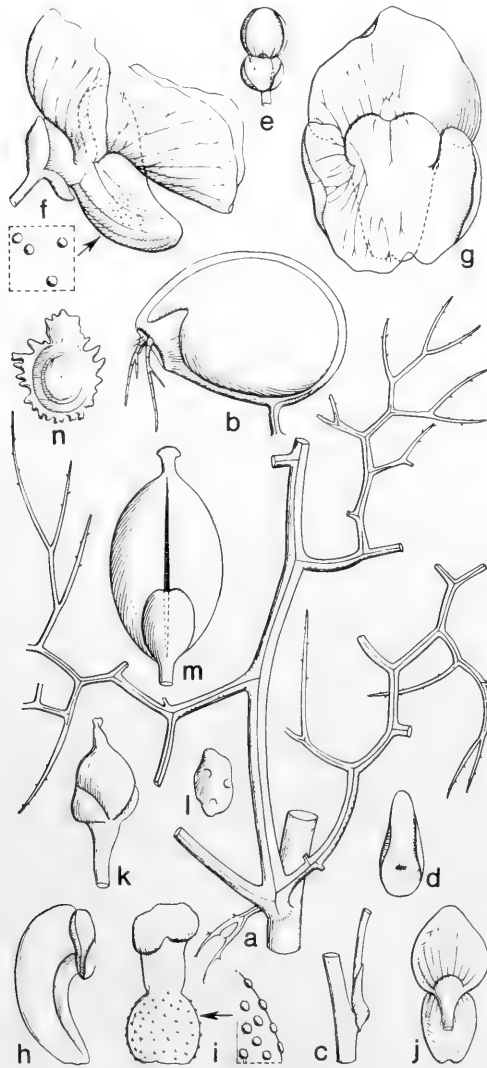


Fig. 19. *Utricularia punctata* WALL. ex A.DC. a. Stolon with part of a branched foliar organ, at the base with stipule-like basal segments, $\times 5$, b. trap, $\times 24$, c. bract in situ, $\times 4$, d. bract, $\times 7\frac{1}{2}$, e. flowering calyx, $\times 4$, f. flower, lateral view, $\times 4$, detail of glands inside spur, $\times 75$, g. corolla, front view, $\times 4$, h. stamen, $\times 15$, i. pistil, $\times 15$, detail of glands on ovary $\times 75$, j. fruiting calyx, $\times 6$, k. fruit, $\times 4$, l. placenta, $\times 4$, m. dehiscent fruit, abaxial ventral view, $\times 6$, n. seed, $\times 7\frac{1}{2}$ (all after LARSEN 82, except b CASTLE 88, j, m FLENLEY 134).

Distr. Burma, Indo-China, Thailand; in *Malaysia*: Sumatra, Malaya, and Borneo.

Ecol. Still or slow flowing water in lakes, rivers and swamps at low altitude. Fl. Aug.–May.

Vern. Banka: *kantur*, *kembang ganga*, *kramor*, M, used as fodder for pigs.

Note. *U. punctata* is anomalous in the 'aquatic' group of the genus (i.e. those with dissected setulose foliar organs) in both the mode of dehiscence of the fruit and the medifixed bracts. RIDLEY stated that the corolla of his *U. fluitans* was 25 mm wide but that preserved on the type specimen is less than half this dimension.

18. *Utricularia exoleta* R. BR. Prod. Nov. Holl. (1810) 430; BTH. Fl. Austr. 4 (1869) 526; CLARKE, Fl. Br. Ind. 4 (1884) 329; FORBES & HEMSL. J. Linn. Soc. Lond. Bot. 26 (1890) 223; GOEBEL, Ann. Jard. Bot. Btzg 9 (1890) 91; TRIMEN, Handb. Fl. Ceyl. 3 (1895) 268; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 119; PRAIN, J. As. Soc. Beng. 74, ii (1905) 368; KOORD. Exk. Fl. Java 3 (1912) 204; MERR. En. Born. (1921) 537; Ent. Philip. 3 (1923) 466; RIDL. Fl. Mal. Pen. 2 (1923) 491; PELLEGR. Fl. Gén. I.-C. 4 (1930) 473; STEEN. Arch. Hydrobiol. Suppl. 11 (1932) 331, f. 8 V; MIKI, Bot. Mag. Tokyo 49 (1935) 847; SPARE, Mal. Nat. J. 1 (1940) 88; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 194, p. 2; SANTAPAU, J. Bomb. Nat. Hist. Soc. 49 (1950) 218. — *U. diflora* ROXB. Hort. Beng. (1814) 4, *nomen nudum*. — *U. biflora* (non LAMK.) ROXB. Fl. Ind. 1 (1820) 144. — *U. diantha* ROXB. ex ROEM. & SCHULTES, Mant. 1 (1822) 169; WIGHT, Hook. J. Bot. Kew Misc. 1 (1849) 372; Ic. (1850) t. 1569; MIQ. Fl. Ind. Bat. 2 (1859) 999; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 176. — *U. roxburghii* SPRENG. Syst. 1 (1825) 52. — *U. pauciflora* BL. Bijdr. (1826) 739; MIQ. Fl. Ind. Bat. 2 (1859) 999. — *U. ambigua* A. DC. in DC. Prod. 8 (1844) 9. — *U. pterosperma* EDGEW. Proc. Linn. Soc. Lond. 1 (1847) 352. — *U. conferta* HASSK. Nat. Tijds. N. I. 10 (1855) 90 (Retzia 1 (1855) 90); MIQ. Fl. Ind. Bat. 2 (1859) 998. — *U. sumatrana* MIQ. Fl. Ind. Bat. 2 (1859) 998, p.p.; Suppl. 1 (1860) 246. — *U. saharunporensis* ROYLE ex OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 176, *pro syn.* — *U. elegans* WALL. (Cat. 1829, n. 1502) ex OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 176, *pro syn.* — *U. gracilis* LEPR. ex OLIVER, J. Linn. Soc. Lond. Bot. 9 (1865) 147, *pro syn.* — *U. amphibia* WELW. ex KAMIENSKI, Bot. Jahrb. 33 (1902) 112, *pro syn.* — *U. exoleta* var. *lusitanica* KAMIENSKI, Bot. Jahrb. 33 (1902) 112. — *U. riccioides* A. CHEV. Bull. Soc. Bot. Fr. Mém. 8 (1912) 187. — *U. nagurai* MAKINO, Bot. Mag. Tokyo 27 (1913) 59. — *U. gibba* L. ssp. *exoleta* (R. BR.) P. TAYLOR, Mitt. Bot. Staatssamml. München 4 (1961) 101; in Hutch. & Dalz. Fl. W. Trop. Afr. ed. 2, 2 (1963) 381; Kew Bull. 18 (1964) 204; Dansk Bot. Ark. 23 (1968) 530; BACK. & BAKH. f. Fl. Java 2 (1965) 51. — Fig. 2f, 20.

Aquatic. *Rhizoids* few, filiform with short botryform branches. *Stolons* filiform, terete, up to 20 cm long or more, up to 1 mm thick, much branched and often mat-forming. *Foliar organs* numerous on the stolons, up to 15 mm long, sparsely dichotomously divided, ultimate segments few, capillary, terete, glabrous or very sparsely setulose. *Traps* numerous, lateral on the foliar segments, obliquely ovoid, stalked, 1–1.5 mm long, mouth lateral,

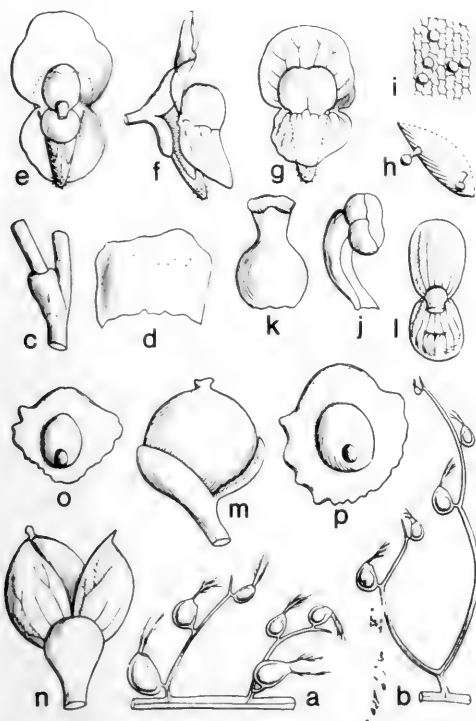


Fig. 20. *Utricularia exoleta* R.Br. a-b. Foliar organs on stolon, $\times 4$, c. bract *in situ*, $\times 6$, d. *ditto*, flattened, $\times 15$, e-g. flower, in adaxial, lateral and frontal views respectively, $\times 4$, h. glands on spur outside, $\times 75$, i. *ditto* inside, $\times 75$, j. stamen, $\times 15$, k. pistil, $\times 15$, l. fruiting calyx, $\times 6$, m. fruit, $\times 6$, n. *ditto*, dehiscent, $\times 6$, o-p. seeds, $\times 15$ (a, e-i JONES 310, b-d, j-l JONES 386, m-n, p ADAMES 201, o JORDAN 2096).

sometimes with short marginal setae, upper lip with 2 long, much branched setiform appendages. Inflorescence erect, 2-15 cm long, solitary or fasciculate; peduncle filiform, terete, glabrous; scales usually 1 near the middle of the peduncle, similar to the bracts; bracts basifixed, transversely oblong or semi-orbicular, c. 1 mm long, apex truncate or obscurely crenulate; bracteoles absent; pedicels filiform, terete, suberect, 2-12 mm long. Calyx lobes subequal, \pm orbicular, apex rounded. Corolla yellow, 4-8 mm long, upper lip orbicular or broadly ovate, about twice as long as upper calyx lobe, 3-4 mm wide, apex rounded or truncate, lower lip similar, palate raised, gibbous, spur narrowly cylindrical from a conical base, straight, apex obtuse, slightly longer than and \pm parallel with the lower lip. Filaments linear, curved, anther thecae \pm confluent. Ovary globose, style short but distinct, stigma lower lip semi-orbicular, upper lip much shorter or obsolete. Capsule globose, 2-3 mm long, firm in texture, laterally bivalvate. Seeds few, lenticular, 1-1.6 mm

wide, with a broad irregular corky wing, testa smooth or slightly verrucose, hilum prominent.

Distr. Tropical Africa, Portugal, India to China and Japan and N. Australia; in *Malesia* common and widespread but not recorded from the Lesser Sunda Is.

Ecol. Shallow still water in lakes, swamps and marshes, also in *Pandanus* swamp forest, largely at low altitude, occasionally ascending to 1600, and even to 2100 m. Fl. Febr.-March, July-Dec.

Vern. W. Java: *lukut tjai*, S; W. Borneo: *veen-parril*, Pontianak; New Guinea: *keenapidu*, Enga lang.

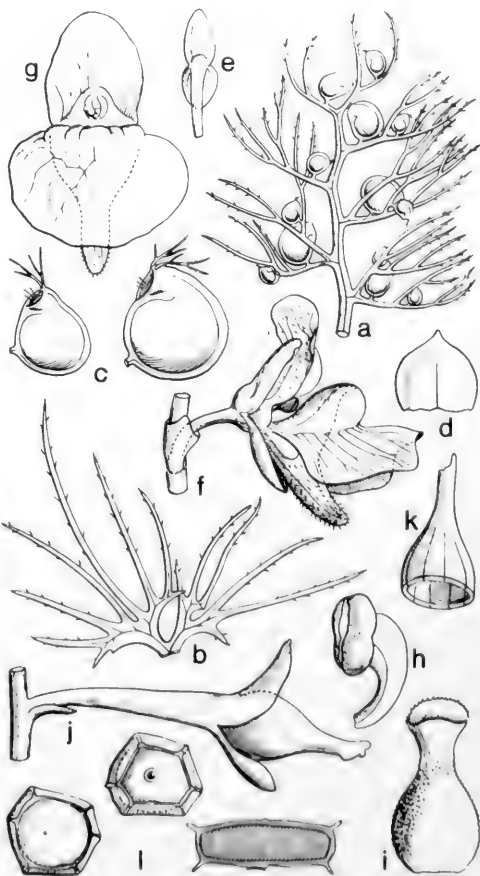


Fig. 21. *Utricularia aurea* LOUR. a. Foliar organ with traps, $\times 4$, b. foliose stipule-like segments at base of foliar organs, $\times 6$, c. small and large trap, $\times 6$, d. bract, flattened, $\times 6$, e. flowering calyx, $\times 4$, f. flower in lateral view, $\times 4$, g. *ditto*, frontal view, $\times 4$, h. stamen, $\times 12$, i. pistil, $\times 12$, j. young fruit, with swollen pedicel, $\times 4$, k. circumscissile upper half of dehiscent capsule, $\times 4$, l. seed, left to right in abaxial, adaxial view, $\times 12$, and in section, $\times 24$ (a, d-e, g, j-k LARSEN & WARNCKE 1663, b-c, f, h-i DARBYSHIRE 605, l HAVILAND 2177A).

19. *Utricularia aurea* LOUR. Fl. Coch. (1780) 26; MERR. Trans. Am. Phil. Soc. 24 (1935) 356; HAND.-MAZZ. Symb. Sin. 7 (1936) 874; STEEN. Trop. Natuur Jub. no. (1936) 123, f. 20; BACK. & BAKH. f. Fl. Java 2 (1965) 517; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 529, *excl. syn. U. fluitans*. — *U. vulgaris* LINNÉ, Sp. Pl. (1753) 18, *partim quoad ref. Fl. Zeyl.* — *U. flexuosa* VAHL, Enum. 1 (1804) 198; BL. Bijdr. (1826) 739; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 175, *excl. syn. U. ramosa*; BTH. Fl. Austr. 4 (1869) 525, *excl. syn. U. australis*; CLARKE, Fl. Br. Ind. 4 (1884) 329; FORBES & HEMSL. J. Linn. Soc. Lond. Bot. 26 (1890) 223; RIDL. Trans. Linn. Soc. Lond. II, Bot. 3 (1893) 327; TRIMEN, Handb. Fl. Ceyl. 3 (1895) 267; BOERL. Handl. 2, 2 (1899) 560; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 119; PRAIN, J. As. Soc. Beng. 74, ii (1905) 368; RIDL. J. Str. Br. R. As. Soc. n. 59 (1911) 144; KOORD. Exk. Fl. Java 3 (1912) 204; MERR. Fl. Manila (1912) 432; BOLD. Zakfl. (1916) 126; RIDL. Fl. Mal. Pen. 2 (1923) 491; MERR. En. Philip. 3 (1923) 466; Lingn. Sc. J. 5 (1927) 167; JACOBSON, Trop. Natuur 17 (1928) 112, fig.; HEND. Gard. Bull. S. S. 4 (1928) 295; MELCHIOR, Bot. Jahrb. 62 (1929) 385; PELLEGR. Fl. Gén. I.-C. 4 (1930) 471; BACK. Onkr. Suiker. (1931) 633; SANDS, Mal. Agric. J. 21 (1933) 175; SPARE, Mal. Nat. J. 1 (1940) 88; SANTAPAU, J. Bomb. Nat. Hist. Soc. 49 (1950) 218; HEND. Mal. Nat. J. 6 (1950) 336. — *U. fasciculata* ROXB. (Hort. Beng. 1814, 4, *nomen*) Fl. Ind. 1 (1820) 143; WALL. Cat. (1829) n. 1568; MIQ. Fl. Ind. Bat. 2 (1859) 997; Suppl. 1 (1860) 246. — *U. confervifolia* JACKS. ex D. Don, Prod. Fl. Nepal. (1825) 84. — *U. flexuosa* var. *blumei* A. DC. in DC. Prod. 8



Fig. 22. *Utricularia aurea* LOUR. Habit, about nat. size, a fruit in natural poise separately (DOCTERS VAN LEEUWEN 2281).

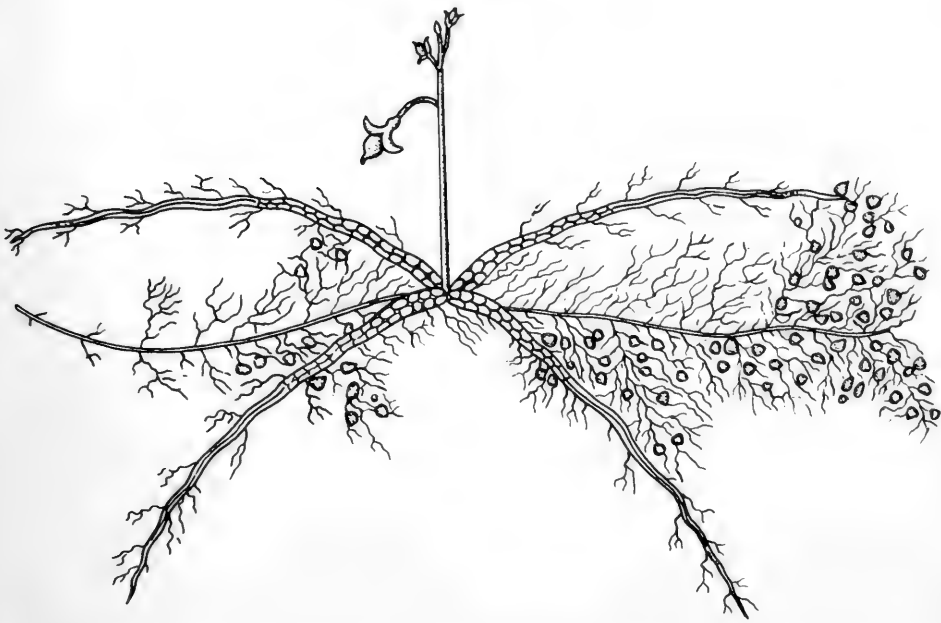


Fig. 23. *Utricularia aurea* LOUR. Form with conspicuous inflated rhizoids from the base of the peduncle, slightly enlarged. In clay ditch in seasonal savanna, Indramayu, W. Java, March 1936 (VAN STEENIS s.n.).

(1844) 24. — *U. inaequalis* BENJ. Linnaea 20 (1847) 304. — *U. calumpitensis* LLANOS, Fragm. (1851) 11; MERR. Sp. Blanc. (1918) 351. — *U. extensa* HANCE in Walp. Ann. 3 (1852) 3. — *U. reclinata* HASSK. Versl. Med. Kon. Ak. Wet. A'dam 4 (1855) 161; Retzia 1 (1855) 92; *ibid.* 10 (1856) 92; BOERL. Handl. 2, 2 (1899) genus 559. — *U. blumei* (A. DC.) MIQ. Fl. Ind. Bat. 2 (1859) 997. — *U. vulgaris* var. *pilosa* MAKINO, Bot. Mag. Tokyo 9 (1895) 111. — *U. pilosa* (MAKINO) MAKINO, Bot. Mag. Tokyo 11 (1897) 70. — Fig. 2c, 21–23.

Aquatic. *Rhizoids* usually present, verticillate at or near the base of the peduncle, fusiform, inflated, 2–6 cm long, 1–3 mm thick (fig. 23), with filiform branches bearing botryform clusters of ellipsoid segments 0.1–0.2 mm long. *Stolons* filiform to relatively thick, up to 50 cm long, terete, branched, glabrous or \pm densely covered with short simple hairs. *Foliar organs* numerous and conspicuous 2–6 cm long, primary segments 3–4, semi-verticillate, filiform or sometimes thick and inflated, each pinnately repeatedly divided from near the base into numerous segments, ultimate segments capillary, terete, setulose; stipule-like clusters of short capillary setulose segments usually present at the base of the primary segments. *Traps* usually numerous, lateral on the foliar segments and sometimes also in the angle between segments, obliquely ovoid, shortly stalked, 1–4 mm long, mouth lateral, upper lip usually with 2 short sparsely branched setiform appendages or without appendages. *Inflorescence* erect, 5–25 cm long; peduncle filiform, terete, glabrous; flowers 5–10, initially congested

becoming \pm distant; scales always absent; bracts basifixed, \pm orbicular, 1.5–2 mm long, apex rounded or subacute; bracteoles absent; pedicels filiform, dorsiventrally flattened, elliptic in cross section, 4–20 mm long, erect at anthesis, usually sharply reflexed and thickened, especially apically, in fruit. *Calyx lobes* subequal, the upper slightly longer, ovate, 3–4 mm long at anthesis, rather fleshy, apex obtuse, margins strongly incurved, very accrescent, up to 9 mm long and spreading or reflexed in fruit. *Corolla* yellow, externally glabrous or sparsely hairy, 10–15 mm long, upper lip broadly ovate, about twice as long as the upper calyx lobe, apex rounded, lower lip larger, transversely elliptic, apex rounded, entire or retuse palate raised, gibbous, spur cylindrical from a conical base, often constricted at the middle, apex obtuse, slightly shorter than and \pm parallel with the lower lip. *Filaments* linear, expanded above, c. 2 mm long, anther thecae confluent. *Ovary* globose, glandular, style relatively long, stigma lower lip orbicular, margin hyaline, ciliate, upper lip much shorter, margin glabrous. *Capsule* globose up to 5 mm long, relatively thick and fleshy, circumscissile, style usually greatly enlarged and elongated, often equalling or exceeding the capsule. *Seeds* numerous, lenticular-prismatic, 5-angled, 1.5–2 mm wide, very narrowly winged on all the angles, testa thin, obscurely reticulate, reticulations slightly elongate.

Distr. India to China and Japan to Australia, throughout *Malesia*, common and widespread.

Ecol. Deep or shallow still water in lakes and

rice-fields, also in pandan swamp forest at low and medium altitude, ascending to 1200 and occasionally to 1500 m. Fl. Jan.-Dec.

Vern. Sumatra: *giamon*, M, Enggano; E. Borneo: *kianibu udang*, Kutei; Philippines: *bagingan gadudugge*, *bagiw di udongo*, If.; New Guinea: *pehra pehra*, Matapaili lang.

Note. This very common species is very variable in size. The inflated rhizoids at the base of the peduncle (fig. 23) are sometimes very conspicuous but often absent.

20. *Utricularia muelleri* KAMIENSKI, Ber. Deut. Bot. Ges. 12 (1894) 5. — *U. stellaris* (non L. f.) BTH. Fl. Austr. 4 (1869) 525, *partim quoad spec.* Gulf of Carpentaria, F.V. MUELLER. — *U. inflexa* FORSK. var. *stellaris* (L. f.) P. TAYLOR, Kew Bull. 18 (1964) 191, *partim quoad syn. U. muelleri* excl. ref. Bot. Jahrb. 33 (1902) 108. — Fig. 24.

Aquatic. Rhizoids apparently absent. Stolons filiform, terete, glabrous, up to 60 cm long, unbranched. Foliar organs numerous and conspicuous, 2-3 cm long, primary segments 3 or more, semi-verticillate, filiform, each dichotomously repeatedly divided from near the base into numerous segments, ultimate segments capillary, terete, minutely setulose; stipule-like clusters of short hyaline flattened densely setulose segments usually present at the base of the primary segments. Traps usually numerous, lateral on the intermediate segments, obliquely ovoid, 1-3 mm long, shortly stalked, mouth lateral, apparently without appendages. Inflorescence erect, 4-15 cm long, peduncle filiform, terete with a whorl of 4-6 spongy floats approximately midway, floats ellipsoid, 10-20 mm long, shortly stipitate, with capillary foliar segments at the apex and laterally and more numerous at the base; flowers 2-14, rather congested; scales absent; bracts transversely elliptic when flattened, cucullate, amplexicaule, hyaline, nerveless, 2.5-3 mm long, apex \pm deeply denticulate-laciniate; bracteoles absent. Calyx lobes unequal, connate, scarcely accrescent, upper broadly ovate, c. 2 mm long, cucullate, apex rounded, lower about as long but broader \pm orbicular, apex emarginate. Corolla yellow with pink nerves on the palate and spur, 6-9 mm long, glabrous, upper lip oblong, cucullate, much longer than upper calyx lobe, lower lip shorter, transversely oblong, apex emarginate, palate raised, gibbous, spur broadly conical, slightly curved, apex rounded, about as long as lower lip. Filaments falcate, c. 2 mm long, somewhat expanded above, anther thecae subdistinct. Ovary globose, style distinct, stigma lower lip quadrate, reflexed, upper lip very short, emarginate. Capsule globose, 3-4 mm long, circumscissile. Seeds few, thinly lenticular, 1.5-2 mm \varnothing including a distinct narrow hyaline wing, testa thin with small conspicuous reticulation.

Distr. N. Australia (Northern Territory and Queensland) and Malasia: New Guinea (Papua).

Ecol. Shallow water in lowland *Melaleuca* swamp forest. Fl. Aug.

Note. *U. muelleri* is superficially very similar to the more widespread *U. stellaris* L. f. which occurs from tropical Africa to Indo-China and reappears in northern Australia, but is apparently absent from Malasia. For differences see the key to the species.

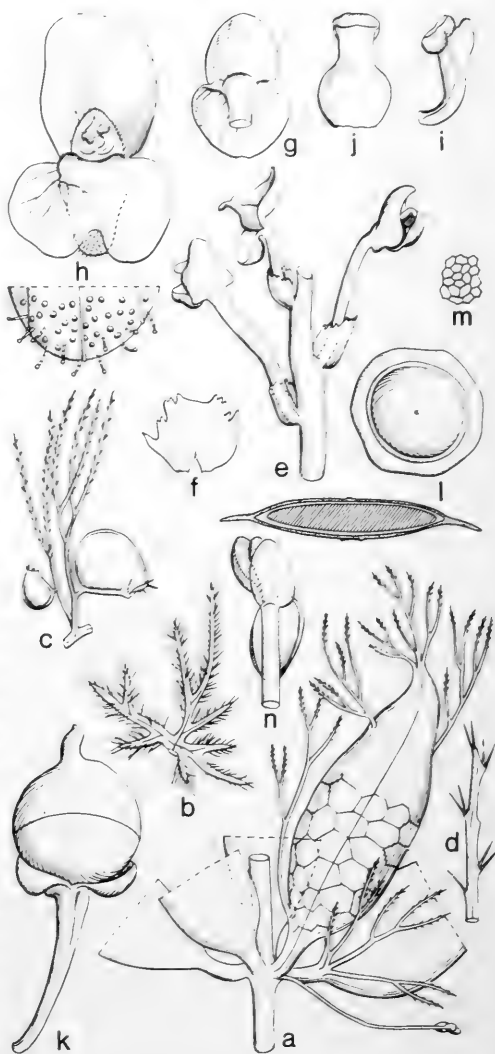


Fig. 24. *Utricularia muelleri* KAMIENSKI. a. Whorl of five floats showing stipites and segments at or near their bases (+ 'air shoot'), $\times 5$, b. hyaline stipule-like segments from base of primary segments, $\times 12$, c. secondary to ultimate segments of foliar organs with traps, $\times 5$, d. apex of foliar segments on floats, $\times 24$, e. part of deflorated inflorescence, $\times 4$, f. bract, flattened, $\times 6$, g. flowering calyx, $\times 6$, h. corolla, front view, $\times 4$, and below it spur apex, with internal sessile and external stipitate glands, $\times 24$, i. stamen, $\times 12$, j. pistil, $\times 12$, k. capsule, with circumscissile line for later dehiscence, $\times 5$, l. seed, $\times 12$, and below it in section filled with embryo, $\times 24$, m. testa, $\times 24$, n. apex of air shoot (a-c, n BYRNES 2381, d-j LATZ 3697, k PARKER 117, l-m PULLEN 7058).

21. *Utricularia australis* R. BR. Prod. Nov. Holl. (1810) 430; A. DC. in DC. Prod. 8 (1844) 6; P. TAYLOR in TUTIN *et al.* Flora Europaea 3 (1972) 297. — *U. neglecta* LEHM. Pugillus Plantarum 1 (1828) 38. — *U. sacciformis* BENJ. Linnaea 20 (1897) 302. — *U. flexuosa* (non VAHL) BTH. Fl. Austr. 4 (1869) 525; CLARKE, Fl. Br. Ind. 4 (1884) 329, *partim et quoad syn.* *U. australis* R. BR. — *U. incerta* KAMIENSKI, Bot. Jahrb. 33 (1902) 111. — *U. japonica* MAKINO, Bot. Mag. Tokyo 28 (1914) 28. — *U. stellaris* (non L. f.) WAGER, Trans. R. Soc. S. Afr. 16 (1928) 204. — *U. vulgaris* (non L.) P. TAYLOR, Kew Bull. 18 (1964) 171. — Fig. 25.

Aquatic. *Rhizoids* 2–4 near base of peduncle, capillary, 1–2 cm long with a few short botryform segments. *Stolons* filiform, up to 50 cm long, terete, branched, glabrous. *Foliar organs* numerous, 1.5–4 cm long, primary segments 2, filiform or sometimes \pm inflated, each repeatedly pinnately

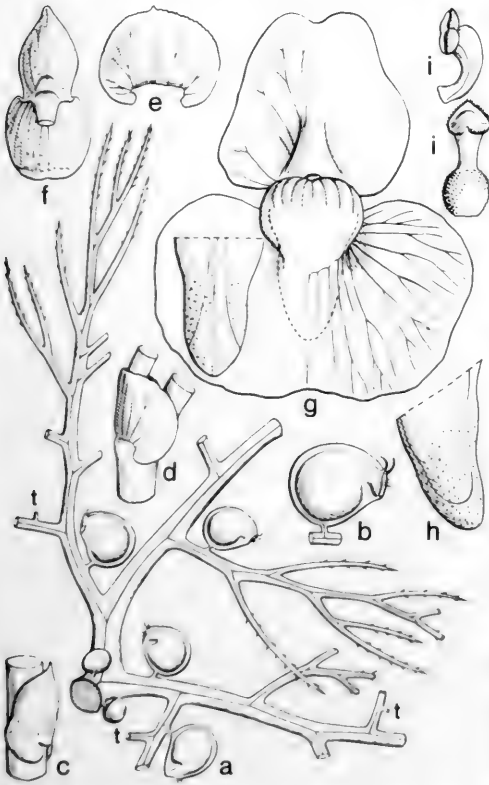


Fig. 25. *Utricularia australis* R. BR. a. Foliar organ, at the base with two rudimentary traps, some traps not drawn indicated by 't', $\times 5$, b. trap, $\times 12$, c. scale, $\times 4$, d. insertion of flower (left stalk), with bract *in situ*, $\times 4$, e. bract, flattened, $\times 4$, f. flowering calyx, lowest margin hyaline, $\times 4$, g. flower, front view, spur separately drawn, $\times 4$, h. spur, lateral view (the punctate glands are internal), $\times 4$, i. stamen, $\times 6$, j. pistil, $\times 6$ (all after ASTON 1799).

divided from very near the base into numerous segments, ultimate segments capillary, distinctly flattened, marginally setulose. Globose or ovoid *turions* (winter buds) 0.5–1.5 cm long of reduced densely setulose foliar segments often present at apex of stolons or stolon branches. *Traps* usually numerous, lateral on the segments and usually also at the base of the primary segments, obliquely ovoid, 1–2 mm long, shortly stalked, mouth lateral, with simple marginal setae, upper lip with two long branched setiform appendages. *Inflorescence* erect, up to 40 cm long; peduncle at first straight becoming flexuous post anthesis, relatively stout, 1–2 mm thick terete, glabrous; flowers 4–10, initially congested becoming \pm distant; scales 2–3 always present in the upper half of the peduncle, similar to the bracts; bracts basifixed, \pm orbicular, 3–5 mm long, base auriculate, apex rounded or obscurely tridentate; bracteoles, absent; pedicels filiform, 1.5–2.5 cm long, erect at anthesis, later \pm spreading. *Calyx lobes* subequal, ovate-oblong, c. 3 mm long, apex of upper rounded, of lower emarginate. *Corolla* yellow, c. 15 mm long, externally glabrous, upper lip ovate to orbicular, 2–3 times as long as upper calyx lobe, lower lip much larger, transversely elliptic, up to 16 mm wide, apex rounded or retuse, palate raised, gibbous, spur cylindrical or broadly conical, obtuse, slightly curved, shorter than the lower lip. *Filaments* linear, curved, anther thecae confluent. *Ovary* globose, style distinct, about as long as ovary, stigma lower lip semi-orbicular, margin denticulate, upper lip very short. *Capsule* and *seeds* not known.

Distr. W. Europe to China and Japan, tropical and S. Africa, India (south to Ceylon) to SE. Australia; in *Malesia*: Sumatra, Java, Philippines, and New Guinea.

Ecol. Pools in swamps, in *Malesia* at high altitudes, 1300–2500 m, often not flowering. *Fl.* April–July, Nov.

Note. This widespread temperate Eurasian species apparently never sets seed and its somewhat sporadic occurrence, mostly at high altitude, in the African and Asian tropics is probably due to transmission of small particles of its vegetative parts by migrating birds. It has been much confused with *U. aurea* but is easily distinguished by its 1 or 2 (not 3 or more) primary foliar segments without basal stipule-like segments and when in flower by the presence of scales on the peduncle.

22. *Utricularia minor* LINNÉ, Sp. Pl. (1753) 18; A. DC. in DC. Prod. 8 (1844) 7; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 176; P. TAYLOR in TUTIN *et al.* Fl. Europaea 3 (1972) 296. — *U. rogersiana* LACE, Kew Bull. (1915) 405. — *U. minor* var. *multispinosa* MIKI, Bot. Mag. Tokyo 48 (1934) 337. — *U. multispinosa* (MIKI) MIKI, Water Phaner. Jap. (1937) 109; OHWI, Fl. Japan (1965) 815. — *U. punctata* (non WALL. ex DC.) P. TAYLOR, Dansk Bot. Ark. 23 (1968) 531, *partim, quoad syn.* — Fig. 26.

Aquatic. *Rhizoids* not clearly differentiated. *Stolons* filiform, terete, up to 20 cm long, 0.1–0.3 mm thick, sparsely branched, glabrous, \pm dimorphic, some green, suspended or floating, others without chlorophyll and buried in the substrate. *Foliar organs* numerous, polymorphic, \pm circular in outline, 0.2–1.5 cm long, \pm palmately divided into rather few segments, the ultimate

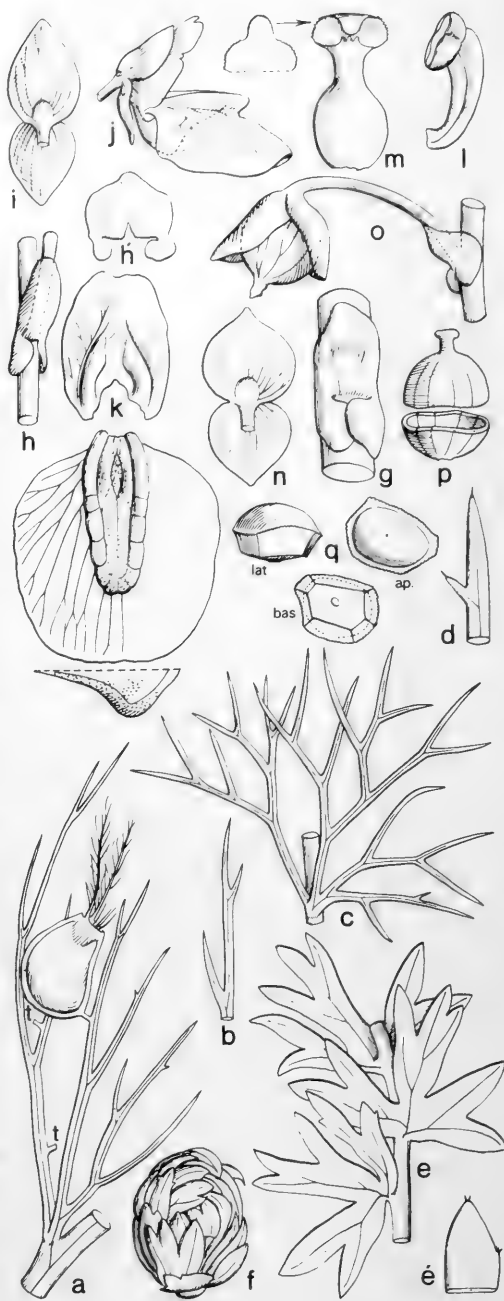
segments flattened, capillary to narrowly linear, 0.1–0.5 mm wide, the margin sometimes sparsely denticulate but not or only microscopically setulose, the apex acute with or without a microscopic seta. Globose turions (winter buds) 1.5–4 mm \varnothing of reduced glabrous foliar segments often present at apex of stolons or stolon branches. *Traps* rather few on the narrower foliar segments, usually absent on the broader ones and most numerous on reduced segments on the subterranean stolons, obliquely ovoid, shortly stalked, 0.8–2.5 mm long, mouth lateral with marginal simple hairs, upper lip with two long much branched setiform appendages. *Inflorescence* erect, 5–20 cm long; peduncle filiform, terete, straight; flowers 2–8 somewhat distant, scales 2–4, \pm equally spaced on the peduncle, similar to the bracts; bracts basifixed, broadly ovate-deltoid 1.5–2 mm long, 1-nerved, apex obtuse, base conspicuously auriculate; bracteoles absent; pedicels erect at anthesis, spreading and apically reflexing in fruit, filiform, terete, 4–7 mm long. *Calyx lobes* subequal, the upper somewhat larger, broadly ovate, c. 2 mm long, apex obtuse, cucullate. *Corolla* pale yellow, 8–10 mm long, upper lip ovate, apex obtuse, lower lip larger, obovate, apex retuse, palate raised, elongate, distally narrowed, spur saccate, c. 1.5 mm long, internally densely glandular. *Filaments* linear, curved, dilated above, anther thecae confluent. *Ovary* globose, style distinct, stigma lower lip orbicular, reflexed, upper lip narrowly deltoid, both fimbriate. *Capsule* globose, c. 3 mm long, circumscissile. *Seeds* lenticular-prismatic, c. 0.6 mm \varnothing , very narrowly winged on the angles.

Distr. Circumboreal, extending southwards into the Himalaya, Burma, and *Malesia*: New Guinea (Mt Hagen area).

Ecol. Shallow water in high mountain swamps, 2500–3660 m.

Note. The three Malesian specimens seen are without inflorescences but there can be little doubt that they are the same as the circumboreal plant. The small, almost glabrous, turions distinguish it from all other species in the genus. Like *U. australis* it is probably distributed by migratory birds.

Fig. 26. *Utricularia minor* L. a. Narrow foliar segments, from stolon, with one trap, $\times 6$, b. ditto, apex of segment, $\times 12$, c. narrow foliar segments, $\times 5$, d. apex, $\times 12$, e. broad foliar segments, with stolon, $\times 6$, e'. apex of broad segment, $\times 12$, f. turion, $\times 6$, g. scale *in situ*, $\times 12$, h–h'. bract *in situ*, and flattened, $\times 6$, i. flowering calyx, $\times 6$, j. flower, lateral view, $\times 4$, k. ditto, upper and lower lip flattened, and below it lateral view of spur, $\times 5$, l. stamen, $\times 12$, m. pistil, $\times 12$, with flattened lower lip of stigma, $\times 12$, n. fruiting calyx, $\times 6$, o. fruit on pedicel, $\times 6$, p. capsule, dehiscent, $\times 6$, q. seed, from lateral (lat), apical (ap) and basal (bas) views, $\times 12$ (a–b, e–f ANU 667, c–d, g, n–q P. TAYLOR s.n., h–m R. B. DRUMMOND s.n.).

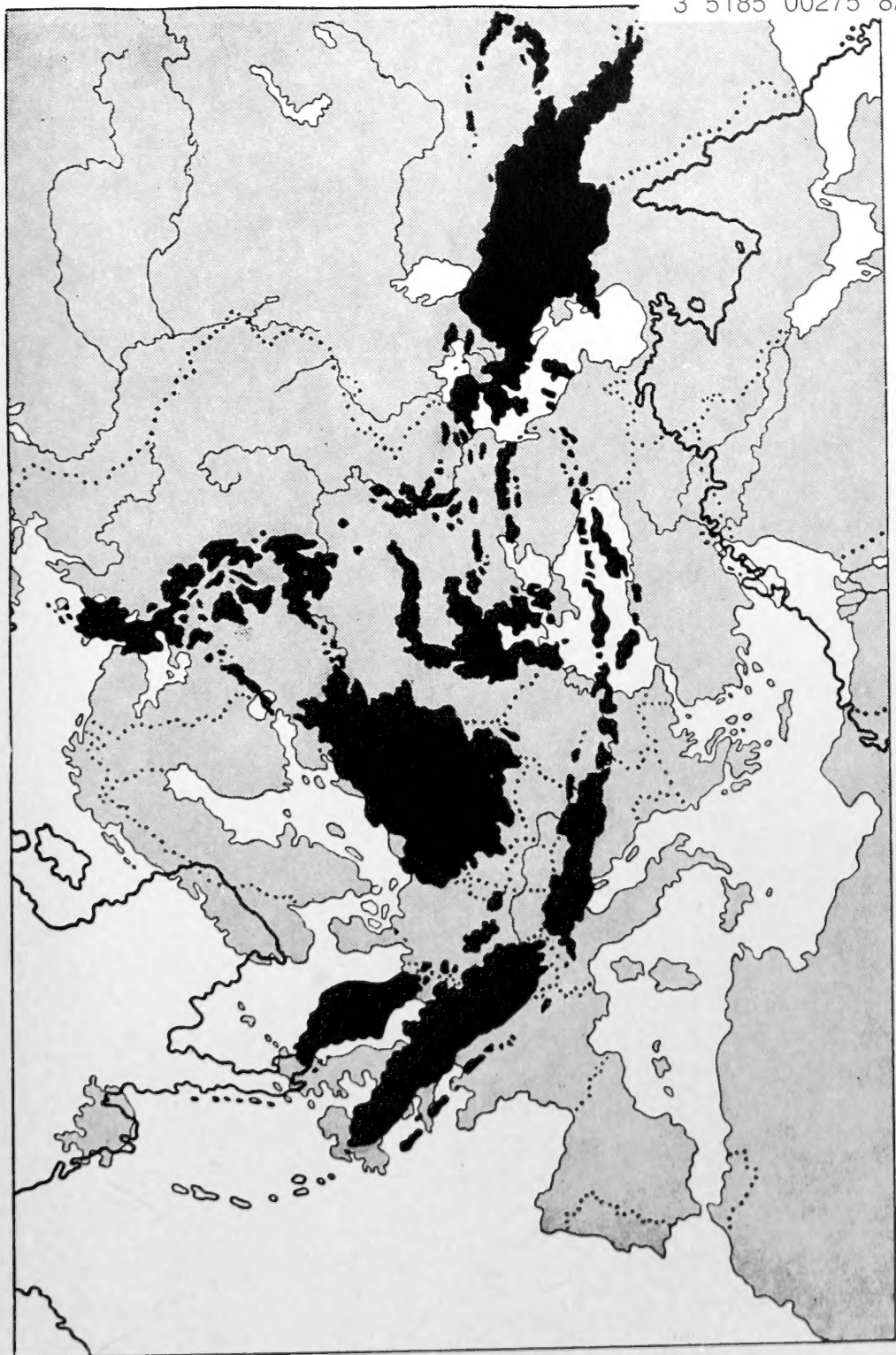


Doubtful

Lemnopsis mnioides ZIPPEL, Flora 12 (1829) i, 285, *nomen*; Alg. Konst- & Letterbode 1 (1829) 297, *nomen*, is according to HALLIER f. Med. Rijksherb. 1 (1910) 40, cf. Fl. Males. I, 4 (1949) 68 = *Utricularia orbiculata* WALL. = *U. striatula* SM.







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